Glimpses of the Cosmos

A Mental Autobiography

By Lester F. Ward, LL.D.

Vol. I. Adolescence to Manhood Period, 1858–1871
Age, 16–30

Vol. II. Scientific Career Inaugurated

Vol. III. Dynamic Sociology

GLIMPSES OF THE COSMOS

BY

LESTER F. WARD

COMPRISING HIS MINOR CONTRIBUTIONS NOW REPUBLISHED, TOGETHER WITH BIOGRAPHICAL AND HISTORICAL SKETCHES OF ALL HIS WRITINGS

> The writings by which one can live are not the writings which themselves live.—JOHN STUART MILL.

Lester F. Ward

From a photograph taken when 45 years of age

MPSES

COSM

L ESTER

RIOD,

G. P. PUTNAM'S SONS
NEW YORK AND LONDON
The Knickerbocker
1913

LESTER F. WARD

Photograph taken when [illegible] years of age

GLIMPSES OF THE COSMOS

BY

LESTER F. WARD

VOLUME III

PERIOD, 1882-1885. AGE, 40-44

Ward's Dynamic Sociology is America's greatest contribution to scientific philosophy.—J. W. POWELL.

G. P. PUTNAM'S SONS
NEW YORK AND LONDON
The Knickerbocker Press
1913

The Knickerbocker Press, New York

PREFATORY NOTE

It may be well to state that this third volume of Dr. Ward's *Glimpses of the Cosmos*, as was the case with the second, failed to secure the advantage of the author's final revision of the proofs while the book was passing through the press. The death of the author occurred just as the printing of the first volume was completed. It was thought wise to leave the text of the following two volumes intact. Thus the first three volumes of the series are presented as containing complete and unaltered the teaching that Dr. Ward desired to bring before the public.

S. E. S.

Appearance of Dynamic Sociology, the labor of fourteen years.

> Die Erfahrung lehrt dass nach dem Eintritt eines lang ersehnten Glückes, wir uns im Ganzen und anhaltend nicht merklich wohler und behaglicher fühlen als vorher.—SCHOPENHAUER.

Address on Heredity and Opportunity, the apotheosis of Nurture as against Nature.

> Mes recherches montrent que la *nurture* a plus d'importance que la *nature*. Il y a 19 causes qui favorisent la production de savants dans un pays et l'hérédité est une de ces causes seulement.—ALPHONSE DE CANDOLLE.

Contents of Volume III.

Illustrations

Glimpses of the Cosmos

April 20, 1882—Ætat. 40.

120. Kant's Antinomies in the Light of Modern Science

History.—Written May 14–June 27, 1881. I was unable to go to Saratoga, and I therefore sent my paper to Dr. Mears on June 28th. It was read on July 6th by Mr. R. W. Hughes (see No. 114, Vol. II, p. 355).

The Journal of Speculative Philosophy, New York, Vol. XV, No. 4. Whole No. 60, October, 1881, pp. 381–395.

IT has become fashionable to regard all controversy as mere logomachy, in which some mere word is the true "bone of contention."

> "And for the word itself we fight
> In bitterness of soul."

This view finds strong support in the undeniable fact that the intensity of sectarian antagonism increases in proportion as the essential doctrines of sects approach each other, until, as well stated by an able writer in "Macmillan's Magazine," "if you want to see men fling away the very thought of reconciliation, and close in internecine conflict, you should look at controversialists who *do not differ at all*, but who have adopted different words to express the same opinion." Such views are strengthened not only by facts of everyday observation, but by such memorable events of history as the two greatest schisms in Christianity, the first arising from the attempt to add a single letter to the Nicene shibboleth, and the second growing out of the appending of a word to the Latin creed.

But while admitting that a large amount of human controversy is of this more or less verbal character, a deeper study of human nature cannot fail to reveal glimpses of more general causes which may even be found to underlie
382 the apparently most base|less disputations. Indeed, the existence of antithetical types of mind, to a large extent incapable of interpreting phenomena in the same way, has been vaguely seen in all ages and by many writers. The Platonic and Epicurean schools of Greek philosophy body forth this conception, and, in fact, seem to have exemplified it with almost as great clearness as any subsequent event. Between these schools nearly every philosopher since that day has, in however vague a manner, seemed to take sides, so that the general cast of his mind upon the fundamental problems involved in them may be deduced from his writings. "Melius autem est naturam secare quam abstrahere," said Lord Bacon; and he adds, "Id quod Democriti schola fecit, quæ magis penetravit in naturam quam reliquæ." This passage, besides its value in fixing Lord Bacon's position in this regard, serves well to suggest one of the chief distinctions between the schools. "Secare naturam" might be taken as the first step in the Baconian method, and the one by which science is specially characterized. Ernst Haeckel, speaking from the point of view of the biologists, defines this constitutional antithesis of the human mind as follows: "If you place all the forms of cosmological conception of various peoples and times into

comparative juxtaposition, you can finally bring them all into two squarely opposing groups—a *causal* or *mechanical*, and a *teleological* or *vitalistic* group." He further invents the terms "monistic" and "dualistic" to distinguish these two conceptions, the last of which refers to the recognition of a power outside of nature acting upon it and in addition to it, while in the former nature is conceived as acting alone.

This wide-spread intellectual polarity may perhaps be in part explained. All philosophy aims to account for phenomena. The human mind is so constituted that no power can prevent it from perpetually striving towards this end. All systems of thought naturally fall under two general divisions. One of these explains phenomena as the product of will and design. A rock, a tree, or an animal is explained on the same principles as a watch; it exists, therefore it has been made. This is the teleological explanation. The other mode of thought claims to recognize a distinction between these two classes of objects or phenomena, and while admitting design in the latter denies it in the former. The rock, tree, animal, are not made, but *have become* what they are. This | conception let us call the *genetic* 383
mode of explanation. The teleological and the genetic modes of explanation are therefore the respective foundations of the two great schools of human thought which severally embrace all men. The only system which ever claimed to disavow both these bases is that of Auguste Comte, and which, in so far, must be regarded rather as a revolt against philosophy than as a system of philosophy.

Under both these general divisions there have grown up numerous more special doctrines which have, each in its turn, formed nuclei for minor systems, to which, according to the special mental proclivities of each individual, men have given their adhesion. To the teleological division, for example, properly belong the doctrines of pure theology or divine free-will, of predestination, and of fatalism. To this also should in part be added that modern truly dualistic school, who hold that all phenomena are the result of unvarying laws once arbitrarily impressed upon the universe. This school, on the other hand, however, except in so far as the primal origin of these laws is concerned, may consistently be classed in the genetic division.

This last-named general class, the genetic, does not possess the number or variety of special sects found in the other, and in all their essential tenets its adherents may be regarded as practically at one. Though apparently of modern origin, the genetic school of philosophy is as old as the fully-developed mind of man. As already remarked, there have always existed the two antithetical ways of looking at the world, and no age has been without adherents to both of these systems. But there are reasons in the nature of things why the teleological habit of thought should, down to within a quite recent period, have maintained an overwhelming supremacy over the genetic habit of thought.

The only philosopher who seems to have clearly perceived the true nature of this fundamental antithesis, and to have attempted a systematic analysis of the principles upon which it rests, was Immanuel Kant, whose centennial anniversary we are here to celebrate. In his immortal "Antinomies," and the profound discussion which follows them, he has laid the foundation in psychology where it properly belongs, for a thorough understanding of this most vital and practically important condition of human thought. His Theses and Antitheses differ only in the character of the
384 | examples given from the primary postulates of the
modern teleologists and genetists, respectively, which latter class are, strictly speaking, the modern evolutionists, and his choice of terms by which to characterize the defenders of these propositions, while they are not those which either party would now select, are perhaps as little objectionable to the one as to the other of these classes of persons.

He calls the one the *dogmatic*, and the other the *empirical*, view of the universe, but in his time and country the former of these terms had not yet acquired that stigma which has since been gradually fastened upon it, and meant a very different thing from that which Douglas Jerrold defined as "puppyism full-grown"; while as to the latter, the practice of opposing empiricism to quantitative scientific determination has also principally grown up since Kant's day. Still, as if somewhat unsatisfied with this word, he sometimes employs a substitute for it, and calls this the *critical* or the *sceptical* method.

In using the term *dogmatic* as applicable to the teleological school, Kant doubtless had in view the fact, so apparent to all, that it was this school that assumed to teach philosophy, being greatly in the ascendancy; and in the words *empirical*, *critical*, and *sceptical*, he, no doubt, recognized the tendency of a few minds at all times to revolt against the prevailing conceptions, examine their assumed principles, and subject them to logical, mechanical, and numerical tests, and to rationalistic criticisms. For he declares that in favor of accepting the former or dogmatic view of things there exist three principal arguments: 1, that derived from *practical interest*, since upon it appear to rest the claims of religion and morality; 2, that derived from a *speculative interest*, since by its aid the entire field of speculation can be compassed by the mind and the conditioned directly derived from the unconditioned; and 3, that derived from *popularity*, since he conceived that the great majority would always be found on that side.

It is interesting and remarkable that so great a mind should be able to find no higher motives than these upon which to base the claims of dogmatism, which meant, and still means, the acceptance of the main body of beliefs of the age. The first is of so low an order that it would seem to be beneath the dignity of a philosopher to entertain
it. For what has a man's practical interest to do with 385
philosophy, with the attainment of truth in the domain of abstract thought? The argument employed by Bishop Butler, that a particular religion should be embraced on the sole ground, if on no other, that there could be nothing to

lose and might be much to gain by so doing, while in the failure to do so there was nothing to gain and might be much to lose, has been generally condemned as of a low order in appealing to practical interest where a question of abstract truth was involved. But Bishop Butler was avowedly a sectarian writer, defending his particular religion, and such low appeals were to be expected. How, then, could Kant justify an analogous argument? As a disinterested philosopher, this would seem impossible. Yet Kant's justification, from his own peculiar point of view, though somewhat amusing, will appear to be quite satisfactory. It is this: Neither the thesis nor the antithesis of any of his antinomies is capable of proof, or rather both are capable of absolute demonstration; and, being contradictories, all argument becomes absurd. With him the universe is a great dilemma, of which any one may take either horn with exactly equal chances of reaching the truth. Of course, therefore, if there is any difference in this respect, he had better choose the one which is most to his interest, and this, Kant thought, was unquestionably the dogmatic.

Fully as much might be said of his third reason for preferring that side, viz., the advantage to be derived from its greater popularity. If possible, this claim possesses a still lower moral weight than that of practical interest, of which it is, indeed, merely a temporal form. Only politicians now urge it as a means of influencing men's opinions. It certainly could never be decently urged except in just such a case as Kant conceived this to be; a case in which it would, otherwise, be absolutely immaterial which side one took. The truth itself was hopelessly unattainable, and, if any ulterior consequences were, as a matter of fact, to follow either decision, one was as likely to escape them by the one course as by the other. The only guide left, therefore, was simply present advantage; and, be that the least greater on the one than on the other side, this should be sufficient to determine the decision.

Kant's second ground for accepting the thesis rather than

the antithesis of his antinomies—*i.e.*, the dogmatic rather
386 than the | empirical or sceptical view of the universe, viz., that of speculative interest—being highly philosophical, deserves more attention. And, logically enough, we find him enumerating among the advantages which the mind is to derive from this course that of *ease* or *convenience* (Gemächlichkeit). Nothing is truer than that teleology is a relief to the overstrained intellect striving to build a universe between two infinities. It is the philosophy of the indolent brain, the *ignava ratio*, and is thus adapted both to the childhood of the world and to all those who weary of intellectual effort. These may be good reasons where all hope of arriving at objective truth is renounced; they could scarcely be admitted under any other circumstances. That there is any greater intrinsic dignity or nobility in a universe created by design than in one created by evolution, few men with scientific habits of thought will probably be able to admit. These qualities are not objective, but subjective. They do not belong to the world, but to those who contemplate it, and thus so much of the supposed speculative interest is carried back to the class of practical interest.

The empiricist of Kant loses all these advantages. In embracing the *antitheses* he removes the foundations of religion and of morality, the latter conceived as deriving all its sanction from authority. "If there is no Primordial Being (*Urwesen*) distinct from the universe, if the universe is without a beginning, and, therefore, without a creator, our will not free, and the soul of the same divisibility and perishability as matter, moral ideas and principles lose all validity, and fall with the transcendental ideas which formed their theoretical support." In this passage Kant evidently fails to distinguish the fine shades on the strength of which many modern scientists so stoutly reject the charge of materialism. Yet he has clearly in view the stern mechanical connection between phenomena which constitutes the basis of the causational philosophy of science.

Empiricism, as thus defined, is not, however, entirely without its advantages. It, too, possesses a certain speculative interest, in defining which the great philosopher still more clearly shows that he had in mind that same universal antithesis in the constitution of the human mind which we sought to describe at the outset.

"Empiricism," he says, "affords advantages to the speculative interest of the reason which are very fascinating,
387 and far exceed | those which the dogmatic teacher of rational ideas can promise. In the former the intellect is always on its own peculiar ground, viz., the field of mere possible experiences, whose laws it can trace back, and by means of which it can expand its own certain and comprehensible knowledge without end. . . . The empiricist will never allow any epoch of nature to be assumed as the absolutely first, or any limit of his outlook into the surrounding world to be regarded as the outermost, or any of the objects of nature, which he can resolve by mathematics or by observation and bring synthetically under his contemplation (*Anschauung*)—the extended—to pass over to those which neither sense nor imagination can ever represent *in concreto*—the simple." Surely, his "empiricist" is here none other than a modern genetist, evolutionist, or scientist.

Even admitting all that Kant maintains for and against the two opposing views, it may still be a question whether the manly independence of the empiricist would not be preferable to the idle respectability of the dogmatist.

Still better to illustrate these two antagonistic phases of thought, Kant asserts that they embody the contrast between Platonism and Epicureanism. Whether the teleologists can fairly regard Plato as the founder or first great representative of their views in philosophy may, it is true, be open to some question; but that Epicurus foreshadowed, as faithfully as could be expected from the state of knowledge in his time, the teachings of modern science and the principles of the genetic causational or evolution-

ary school, cannot be candidly denied. And, if his sect did nothing else, they clearly proved that this apparent question of opinion really has a psychological basis, and exists deep in the constitution of the human mind, more or less independently of the condition of human knowledge in the world. There always have existed a few minds unwilling to accept the dogmatism of the mass. There always crops out in society a more or less pronounced manifestation of rationalism as opposed to authority. While this class of views finds few open advocates, it always finds many tacit adherents, and, when uttered, a large, though usually irresponsible, following. Criticism of received beliefs is always sweet to a considerable number who rejoice at the overthrow of the leaders of opinion or the fall of paragons of morality. And this it is which | often renders the peace of society in- 388
secure. The established code of morals is dimly felt by the lower classes to be in some respects radically unsound. The broad contrast between men's nominal beliefs as spoken and their real beliefs as acted is apparent even to children. The standard of conduct is so much higher than that which the controllers of conduct can themselves live up to, resulting always in the punishment of the weak and the poor for the same transgressions as are daily committed with impunity by the rich and the powerful, that the lowest miscreant sees that there is some fundamental wrong underlying the entire social fabric, although he can not tell what it is.

All this must be regarded as the legitimate consequence of the undue supremacy of dogmatic ideas and teleological conceptions in society. So far from favoring morality, they are the direct cause of the most dangerous form of immorality, viz., a mutinous revolt against too severe and unnatural moral restraints. Rules of conduct based on these conceptions are necessarily arbitrary, while the normal intellect naturally demands a reason for its obedience.

While these truths are equally applicable to all classes of conduct, we will illustrate them here only in one. That the

prevailing sentiment of society on the question of the purity of actions which spring from love is in large measure false, and in so far injurious, is evident from many indications. The steady refusal of the popular pulse to beat in unison with moral precept respecting it may be counted among the most significant of these indices. In fact, it is very curious, and suggests the demoralizing tendency of too high moral standards, to observe to how great an extent the moral code is upheld in word and violated in action. Many persons, when questions of this class arise for discussion, will defend the side of dogmatism who at the same time are really in sympathy with the side of scepticism. The real popularity of this side, when it finds an opportunity to express itself through channels that are deemed respectable, and where its real nature is likely to remain concealed, is well shown by the manner in which works of fiction are demanded and the stage is supported. These agencies are the natural defenders of the critical side of this question, which constitutes almost their only mission and *raison d'être*. They usually aim to demonstrate the essential
389 | purity of such acts, dictated by the sexual emotions, as the ethical canons declare impure. A romance or a drama which should fail to administer some such rebuke to the accepted tenets of orthodox morality would be adjudged tame, and would prove a financial failure. Every one knows with what avidity this class of critical literature is devoured by the public and its dramatic representation is applauded. In fact, as already remarked, there exists throughout society, and probably always has existed, not only with respect to this class of acts, but with respect to many others, a deep-seated rebellion against much that claims to call itself κατ' ἐξοχήν, moral or right—as it were, a vague consciousness, which the average intellect cannot formulate, of the arbitrary and factitious character of the moral and social codes, through the shadowy form of which may be dimly seen the half-unconscious recognition that human action is the product of fixed mechanical laws, that

there is no absolute good or bad, but that these qualities are relative to the benefit or injury done to beings susceptible to pleasure and pain, and that the arbitrary rules of society based on the negation of these truths fall far short of their extravagant claims in regulating the conduct of men.

But returning to the antinomies themselves, and considering the problems presented by the thesis and the antithesis of each in the light of what is now known, and by the aid of modern methods of investigation, we shall see that it is *not* true that both sides admit of equal proofs and disproofs. Disregarding Kant's logical demonstrations as worthless at his own showing, since they reduce the argument on either side to an absurdity, and appealing to the inductive method, which, without claiming infallibility, has wrought such mighty results for man, we may with safety maintain that the side of these questions which Kant calls the empirical has gained upon that which he calls the dogmatic in about the same proportion as the knowledge of the nature of things has increased in the world. The spirit of opposition to teleological conceptions could make no headway as long as so little was known of natural processes. Lucretius might write *De Rerum Natura*, but what he could say that was true must go unsupported by facts and be discredited, while much that he must say that was false would be disproved and throw still greater discredit upon his system. In a state of profound ignorance of the universe, teleo | logical explanations were the only ones the world
would accept. They could be understood; genetic 390
explanations could not. Appearances were all on one side. The deeper truths could not be comprehended. The greatest paradox which nature presents is that of *adaptation*. The word itself contains an ambiguity. It possesses both an active and a middle or reflective sense. The former is teleological, the latter genetic. Adaptation in a purely passive sense is admitted by all. No one denies that there exists a great amount of correspondence between apparently

very distinct objects. It is evident that they have in some way been made to correspond. The vital question is: How and by what power have they been so made? The teleologist says: By a power from without; by design. The genetist says: By a power from within; by adaptation. Just here is the grand schism.

It is easy to see, too, why the teleologists should at first and for a long time enjoy a supremacy. The teleological answer to any question requires comparatively little intellectual effort. It is the easiest way of explaining things, the first explanation that suggests itself. Not only is it intrinsically more simple, but it is more in accord with human experience and the natural habit of thought. In other words, it is anthropomorphic. It is most natural to explain natural phenomena in the same way that artificial phenomena are explained. A garment is adapted to the body that is to wear it. A duck's foot is adapted to the water it swims in. The explanation of the first of these facts is known; that of the second is unknown. Why not infer it from that of the first? There exists no other *known* explanation. To sit down and evolve one of an entirely different kind is not only a laborious task, but, when announced, it must remain unproved until a vast amount of scientific investigation shall have established a broad basis of induction. The sceptic, therefore, who in the infancy of human thought had the temerity to suggest that things may have worked out their observed relations of correspondence through the inherent activities residing within themselves, was met, naturally enough, with derision. Yet every step that science has taken has been in the direction of disproving the popular and confirming the unpopular view. It has been gradually but steadily vindicating reason as against analogy, and establishing a causal as against an arbitrary connection between related facts.

391 | To sustain this statement, let us consider the principal antinomies somewhat more closely. For this purpose the first and third may be selected. As

regards the second, it seems scarcely applicable to this discussion. If there is any difference between its two propositions, in this respect, the one Kant calls the antithesis would seem to be the more dogmatic. So far as the facts of science are concerned, they tend to sustain the view that matter is a reality, and as such must possess a real ultimate unit—the atom—not, indeed, of chemistry, but of a *transcendental chemistry*, which is the domain of reason, as it reaches down below the sensible world of phenomena. Those are usually regarded as the dogmatists on this question who, like Boscovitch, and, we might add, Herbert Spencer, seek to resolve matter into "centres of force," and other ontological conceptions.

Let us examine, then, Kant's first antinomy: "The universe has a beginning in time, and is also enclosed within limits in space;" the antithesis of which is: "The universe has no beginning, and no limits in space, but is eternal in time and infinite in space." Has science anything to say on this question, and, if so, which side does it espouse? Undoubtedly science has to do with it, and it also clearly takes sides upon it. Quantitative chemistry, scarcely born in Kant's time, has practically demonstrated the infinite duration of the universe in establishing the indestructibility of matter. Astronomy, to which Kant's own immortal "*Theorie des Himmels*" helped to give its rational impetus, has now so expanded the conception of space that it has become habitual to regard the universe as absolutely without limits. If any one doubts this, let him make an effort to go back to the old dogmatic conception, and figure to his mind a beginning or end to its duration, or boundaries to its extent. He will find this impossible, and this impossibility is wholly due to the increased knowledge of the universe which science has given to the world. It was once possible, it is still possible to the ignorant, to set bounds to time and space, but inductive science has swept away such crude scaffoldings and opened up to the human mind a view of the infinite.

It is no longer a transcendental question. It is a scientific one, to be solved, like all other scientific questions, by the accumulation of facts. Nothing in concrete science is
demonstrated|*a priori*. The practical truths of the uni-
392 verse are established *a posteriori*, by massing the evidence. In many of the questions now regarded as settled, the evidence has long been conflicting, and much still remains in some to be removed. Yet these residual facts are admitted by all to be overborne by the weight of evidence opposed to them. Such is the character of the greater part of the scientific truth of the world. But the questions involved in Kant's antinomies differ from ordinary scientific problems in two respects. On the one hand, infinity must be proved, which demands, of course, better evidence; but, on the other hand, there are no facts opposed to infinity, but all the evidence is on one side. Not one circumstance can be named which points to a beginning or end of either time or space, while every fact and every law that human observation and reflection have brought forth point to the boundlessness of both in all directions. Only ignorance of these facts, and failure to exercise the rational faculty, can prevent the mind from conceding this truth.

The third antinomy has the following for its thesis: "Causality, according to the laws of nature, is not the only causality from which the phenomena of the universe may be derived. It is still necessary to assume a causality through freedom for the explanation of these phenomena." The antithesis is: "There is no freedom, but everything in the universe takes place according to the laws of nature."

The great issue is here squarely stated, and here it is that accumulating knowledge of the nature of things is working steadily and uniformly against the dogmatic, and in favor of the empirical side. Absolutely no facts are being discovered in favor of freedom, while everything is ranging itself on the side of universal law. From one department of knowledge after another, and in inverse proportion to the complexity of the phenomena, and hence in direct ratio to

the ease with which they are comprehended, science is eliminating all the facts which require the hypothesis of freedom for their explanation. From astronomy, from geology, from physics and chemistry, these eons have been successively expelled; they are now being driven from their fortifications in biology to their citadel in psychology. Even here they are vigorously attacked by the school of Bain and Spencer on the one hand, and that of Flourens and Ferrier on|the other. The very freedom of the human will is
shown to be a delusion, and the interval between morals 393
and physics is spanned by the heartless clinics of Maudsley.

We need not go further and state the fourth and last of Kant's antinomies relating to the existence or non-existence of a "Necessary Being." The first and third Antitheses, established, constitute the premises for the establishment of the fourth. Eternal matter, with its equally eternal activities, suffices to account for all the phenomena of the universe, which are as infinite in causation as in duration or extent. Again, all departments of science confirm this truth. When Laplace was asked how he could have written so great a work as the *Mécanique Céleste* on the subject of the system of the universe, without once mentioning its Author, he replied: "Je n'avais pas besoin de cette hypothèse là." All the more complex sciences are, one by one, and in the inverse order of their complexity, also dispensing with this hypothesis. Like many other once useful hypotheses, that of *theo-teleology*, which, as already remarked, was suggested from analogy with the fact of *anthropo-teleology*, has ceased to be useful, and where still adhered to becomes a burden to the progress of truth. In astronomy the nebular hypothesis which Kant founded, and Laplace demonstrated, has completely superseded it. In chemistry and physics, the atomic theory, formulated as a philosophy by Democritus, and established as a science by Dalton, renders it redundant. In biology the law of adaptation, clearly stated by Lamarck, and that of selection, cumulatively demonstrated by Darwin, and the interoperation of these and that of heredity, thoroughly set forth by Spencer and Haeckel, have freed this field from teleological trammels almost as completely as those of the less complex sciences have been freed from them. And thus is science marching relentlessly forward, and reclaiming one field after another that had been so long given over to dogmatic conceptions, until there is now scarcely room to doubt that its conquest must ultimately become complete.

But what is this that has thus been accomplished? It is nothing less than the establishment of the Antithesis or empirical proposition of Kant's antinomies. They have been removed from the domain of transcendental philosophy, subjected to scientific methods, such as are applied to all other truths, and proved, as | other propositions are
394 proved, by the accumulation of legitimate facts. The eternity of matter and motion and the infinity of space have passed into scientific postulates, and the uninterrupted and unlimited causal dependence of all phenomena in their relation of antecedents and consequents is the fundamental axiom from which all scientific investigation now proceeds.

Though these truths may seem clear to us to-day, though we may have become so thoroughly imbued with the spirit of modern scientific thought that they are little more to us than truisms, we must not forget that the mental atmosphere we now breathe has been purified during the past century, and that what we are, as it were, born in possession of, Kant could only gain by the profoundest meditation. And, when we further contemplate that great mind as constitutionally of a teleological or dogmatic cast, we may realize the immense power it must have possessed to penetrate the mists of both the objective and subjective darkness in which he lived, and formulate, even for his opponents, the arguments by which they were to win their victories. It is the misfortune of the teleological school of to-day that they are incompetent to contend with the genetic school on the same plane of activity. The latter find no difficulty in transferring their base of operations from a scientific to a dogmatic field, and giving battle on the enemy's own grounds. This is doubtless because they are, for the most part, themselves converts from dogmatism, which still constitutes the bulk of most men's early education, and they know how temporarily to return to their old, familiar haunts; but those who have never crossed this boundary are either unable or unwilling to look over and see what is beyond. In their attacks upon science, therefore, they confine themselves chiefly to the free use of epithets which have a stigma only for dogmatists, and cannot, of course, fail to display such a profound lack of acquaintance, not with science alone, but with the very ways in which science carries conviction to the mind, that the effect upon the only ones they would influence is usually little more than amusing.

The concluding thought of this paper is therefore to hold up the great thinker, whose hundredth anniversary we are here to commemorate, as an example to be followed, so far as that is possible, by all those who feel that the empirical, the critical, the sceptical method is advancing
too rapidly, and who would impose upon it a whole- 394
some restraint. For, just as in the field of battle a thorough knowledge of the enemy's position force, and movements is of the highest possible value, so in the field of philosophy, in its broad, practical developments the secret of successful logic lies in the power to impress the contestant with a complete mastery of his side of the controversy as well as one's own. This power, of all logicians, Kant most preëminently revealed, even pointing out to his opponents elements of strength and grounds of justification which they in their blind zeal had only intuitively perceived, if at all. And there can be no doubt that science and rational philosophy would not only welcome a contest of this enlightened kind, but would seek to profit by it, as they profit by every means of advancing the cause of truth in the world.

121. Scientific Basis of Positive Political Economy.

History.—Written March 17 to July 23, 1881. It was sent to the *Penn Monthly* on July 25th, but was returned with the request that I select portions of it, as they had not space for so much. This I did not care to do, as it constituted a connected argument or treatise, and would suffer by reduction. I therefore held it for a favorable opportunity. The first part was thoroughly revised, almost re-written, in the fall of 1881, and when I was asked to contribute the whole to the *International Review*, I revised the second part. As the articles were running through the press it occurred to me that they might be included in the eighth chapter of *Dynamic Sociology*, which had not yet been sent to the printer, and this I proceeded to do, and the whole subject of the classification of phenomena occurs near the end of that chapter substantially as it appeared in the *International Review*. The latter, however, antedates the book by more than a year.

The International Review, New York, Vol. XII, No. 4, April, 1882, pp. 352–365; No. 5, May, 1882, pp. 439–453.

FIRST PAPER.

THE OBJECTIVE POINT.

THE greatest present need of the advocates of a positive political economy is a theoretical foundation for their views. The dominant system, since Adam Smith, has derived its chief strength from the rigidly logical theory upon which it rests. Its defenders assert that it is the only possible logical system, and pronounce the doctrines of those who would regulate industry, commerce and other social phenomena as mere practical makeshifts, capable only of temporarily benefiting a few at the expense of many, and as empirical and unscientific, and hence indefensible on any cosmopolitan or philosophical grounds.

Thus far the positive economists have scarcely done more than accept this impeachment, though without receding from their position; and it must be confessed that, when trying to defend it, they often employ arguments calculated to justify their opponents' claims.

The leading exponents of social science—those who, unlike many who make free use of that expression, know what science is—are for the most part ranged on what may be called the orthodox side of the question, and the effort is constantly being made to show that this is the side on which science itself and all true philosophy are also arrayed.

It is, therefore, time to subject the doctrines of positive economy to scientific tests, and to ascertain whether there exists any logical theory upon which they can be based. It is customary with men of business, whom these doctrines most concern, to smile at theory as a thing of no importance, and to value only that which is obviously practical. The unwisdom of this attitude is shown by the power which the prevailing theoretical system still wields, a power derived entirely from the consistency of its fundamental theory. The world cannot be prevented from reasoning, from philosophizing and theorizing, and the saying that "ideas rule the world" becomes more universally true the higher the degree of intellectual development in society at large.

It must not, however, be supposed that because a doctrine rests upon a logical theory the ultimate truth is therefore necessarily|reached. The history of science is strewn
353 with abandoned hypotheses which were consistent with the state of knowledge in their day. Epicycles, caloric, phlogiston, electric fluids, cataclysms, all have gone, and given place to juster conceptions of the truths they dimly foreshadowed. In seeking after truth the mind very properly generalizes as soon as it possesses sufficient material out of which to construct a theory. Each such generalization is an adumbration of a truth; it is, in fact, a partial or relative truth. But there are ever-widening circles of truth, and any proposition is true relatively to the magnitude of the circle to which it applies. The world moves and human comprehension expands, life is amplified, and the theories of life must be enlarged to correspond with the growth and progress of civilization.

The papers which are to follow will aim to show that the highest generalization which the present state of science enables us to make fully sustains the theory of positive political economy, and, in so far as they are in conflict, condemns that of the negative political economy which has prevailed for the past hundred years, and that a true social science is as sterile without this, its legitimate application, as physical science would be in the absence of all application of its principles to the practical arts.

CLASSIFICATION OF PHENOMENA.

It is tautological to say that we know only phenomena. Phenomena are simply appearances or manifestations, and these can only exist in correlation with sense-perception. This is the starting point of all knowledge. Whatever comes within the range of perception is a manifestation to the sentient faculty; therefore, everything of which anything can be predicated is phenomenon. Feeling, knowing, and thinking beings are placed in the midst of a universe of perceivable processes. These are not a part, but the whole, of their experience, and constitute, so far as the psychic faculty is concerned, their universe.

Phenomena consist entirely of changes—*i.e.*, of actual alterations of location in the objects which make up the universe. These alterations of location are called motions. Unless something moves, there can be no manifestation, no perception, no knowledge. The existence of phenomena, as testified to by consciousness, proves, with all the authority of consciousness, that objects both exist and move. All there is for mind to study is these moving objects. To say that phenomena are perceived is, therefore, a circular proposition, and would be quite useless but for the fact that it suggests an ulterior truth. This|truth is that objects
in motion produce effects. Sensation is the pri- 354
mary effect, but perception and experience teach that similar effects are produced everywhere where contact occurs. The effects produced upon the sensitive organism, unless too violent, reveal the nature of the effects produced upon other objects, and the greater part of all knowledge consists of such indirect observations.

Ignoring, temporarily at least, the nature of the moving objects, it is a convenient as well as a correct view to regard the perceptible universe as made up of changes, which alone constitute the subject of intellectual contemplation, as well as the sole objects of possible conscient interest. This being the case, almost the first question which the normal mind will raise with regard to them will be: How are they caused? The causes of observed phenomena have always formed the first, and we may almost say, the only, problems of philosophy.

There are two modes of conceiving the occurrence of phenomena, and, as we shall presently see, these have a basis in fact, but their historical order is the reverse of that in which they appeal to the mind. According to one of these conceptions, material objects are acted upon by a

power outside themselves; according to the other, they are automatic, or not so acted upon. The first of these conceptions is readily grasped as being based on the analogy of voluntary muscular action upon external objects; as to the second, though it might have been easily deduced from the supposed independence of the voluntary conscious agent, such was the distance which the early mind placed between the animate and the inanimate that this analogy appears not to have been perceived until so late that the absolute freedom of the former had begun to be called in question. It has thus happened that the idea of the independence of phenomena, as a conception of the mind, was a late development of scientific thought, and scarcely finds a place in any of the schemes of the Cosmos. Spontaneity—*i.e.*, the power of a body to originate its own motion from a state of rest, though really inconceivable and contrary to the laws of thought—has indeed been illogically assumed; but the only form in which either reason or science is willing to accept the notion of change not caused by an outside power is that which simply negatives the state of rest and recognizes absolute continuity of motion. But, though a late form of thought, this is now becoming an essential factor in the cosmology of science, and is regarded as the primary, and from one point of view the only, cause of all phenomena. *Transitive* changes, as the opposite class may be called, become subordinate to | these automatic changes, and
355 are interpretable as special manifestations of force due to accidental impacts. These transitive phenomena have always been associated in the human mind with an anthropomorphic volition, and this is usually the part most particularly noted in their contemplation, so much so that it has generally been regarded sufficient to designate them as *teleological*, which denotes this quality only, without connoting the more essential one of extraneous power, as such. As the automatic conception gains ground the teleological one loses, and fears have been entertained lest the fullest concession of the former should be followed by the complete

abnegation of the latter. But while it seems necessary, so far at least as science is concerned, to dismiss *in toto* the transitive along with the teleological conception as universal principles, nevertheless these conceptions must ever remain as legitimate representatives of objective phenomena within the more modest limits above specified, and we shall presently see to how large an extent existing phenomena, and particularly those of the highest class, as affecting the human race and society, partake of this character.

Yet, when dealing, as at present, with abstract principles and the highest cosmological generalizations, we are, as Kant has pointed out, absolutely compelled, if we would proceed at all, to assume the full truth of the first of the two theories above defined, and to admit that the phenomena of the universe are the result of material motions which have never been either more or less in amount than they now are, and which only manifest variety in consequence of the varied nature of the developed aggregates constituting the material world.

With this postulate there can be but two possible kinds of changes, viz., first, original movements of translation in bodies conceived as not at all affected by others; secondly, changes due to the influence exerted upon bodies by the motion and impact of other bodies. The first of these classes of changes, in view of the constant interaction of the matter of all space, is, so far as human experience goes, purely theoretical; but it nevertheless constitutes the essential condition to all observed phenomena. Of these intransitive, original motions of continuity we need not further speak here, as they do not directly concern the present discussion. The other or transitive class of changes may be further subdivided into *physical* or *direct*, and *psychical* or *indirect;* and, since the law of gravitation teaches us that all bodies are actually influenced by all bodies, all phenomena may be reduced to these two categories.

| The physical and mechanical law of the impact of bodies is well understood, and has long been relegated 356

to the domain of pure mechanics. It need, therefore, only be referred to here in order to contrast it with the other form of transitive causation, which we have denominated psychic. Physically produced changes are no less due to causes than psychically produced ones. The cause is in all cases the immediately antecedent changes and resultant impacts; but, as these are simply links in a literally endless chain of causation, and due to motions that belong to matter and are inseparable from it—having, therefore, never had any origin in time—it is a natural error of the mind to look upon them as spontaneous. Some who appear to conceive the nature of phenomena correctly employ this expression, but it is to be strongly condemned as implying the power of origination, and with it the fact of a beginning in the series of phenomena; conceptions opposed to the reality. What term to use for the adequate expression of this conception has been a serious difficulty in modern science. Numerous efforts have been made to resolve this perplexity, some of which have attained a partial success, but much remains still to be done. Of the many forms of expression which have been proposed as calculated to convey this particular notion, comparatively new to the human mind and absent from human vocabularies, the one which probably comes nearest to satisfying all possible cases is that which describes the entire class of physical phenomena as *genetic*. This word combines, better than any other, the idea of causation in all its delicate forms with that of continuance, without connoting either an *origin* or a *purpose*. It furnishes an adjective for the German *Werden*, which may itself be fairly translated by the Greek γένεσις, *genesis*.

Psychic phenomena, while it cannot now be doubted that they, too, are indirectly genetic in the sense that mind itself must have had a genesis, differ in many marked respects from those which are the immediate results of physical causes, and stand in wide contrast with them in all their principal characteristics. Formerly, a large part of the changes now known to belong to the genetic class were

supposed to be of psychic origin; but the tendency of science has steadily been in the direction of limiting this class to those which are known to emanate from organized beings endowed with a nervous system and some form of animation. Whatever may be the fact in this regard, it is at least no longer safe to speculate upon the assumed psychic origin of any phenomena which cannot be shown to have proceeded from such | organic forms as possess in their organiza-
tion the active principle of life called ***protoplasm***, how- 357
ever slightly this substance may have been coördinated and integrated into a compound and complex organism. But, while there are various degrees in the manifestation of this power of apparently spontaneous causation, depending upon the degree of organization of the creature, some of which degrees are so wide as almost to constitute generically distinct forms of force, the psychic phenomena all agree in one essential particular, viz., in manifesting a ***purpose***. As causes of change, mental efforts always represent *final causes;* psychic phenomena are always *teleological.*

There are, therefore, two principal classes of phenomena, according as they are genetically or teleologically produced; and it hence becomes important, before proceeding further, to examine somewhat closely the precise nature of each of these two antithetical forms of causation, and to emphasize the qualities by which they are distinguished. We will consider each of these classes separately.

GENETIC PHENOMENA.

We have already seen that all physical phenomena must be genetic. The only conceivable exception would be the movement of a free element independent of all others. This condition the actual multiplicity of things, so far as human observation can determine, completely negatives. It is true that objects move by virtue of inherent activities inseparable from them, and which in the aggregate are incapable of either increase or diminution, but such is the existing plexus of material elements that the particular forms of change actually produced are determined by the interaction of multiple influences, and each phenomenon is the resultant of all the forces in operation to produce it. The simplest form of a phenomenon is seen in the impact of two bodies, and the phenomenon itself will depend, according to known mechanical laws, upon the respective masses, velocities, directions and elasticities of the bodies. However complicated the phenomenon, the same laws operate with rigorous exactness, though this truth is veiled by their subtile interaction. The conception of *force* or *energy* can have no other basis of fact, and all effects of whatever kind flow from the immediate physical contact of moving objects.

This truth, clearly comprehended, contains the key to the nature of all genetic phenomena. Genesis is only another name for causation, and causation is the production of change through impact. The failure to grasp this principle has arisen chiefly from the fact that a | large pro-
358 portion of the phenomena of the perceptible universe are *molecular*, and it has been difficult to regard molecules as identical with masses in all respects except that of magnitude. There has prevailed a species of mysticism respecting them not unlike that which savages feel in the presence of the invisible atmosphere. They have been reluctantly admitted into the category of things, and molecular physics has, in fact, been a sort of metaphysics. But the more we learn of molecular phenomena the more we find them to resemble molar phenomena, and we are justified experimentally, as we certainly are *a priori*, in pronouncing matter uniform in its laws.

A *causa efficiens*, which is the essence of the genetic process, is simply a direct and immediate cause—one in which there is neither interval nor indirection between the cause and the effect. This forms, too, the leading distinction between genetic and teleological phenomena. In the former the cause is always in immediate antecedent connection with the effect.

Another consideration must now be taken into account. Genetic phenomena are observed in most cases to occur in prolonged series. There is seen to be a tendency toward the recurrence of the same set of changes in a single direction. Observed at considerable intervals of time, the changes produced during one interval are seen to be continued through the next, and results effected are more or less permanent, to be carried further at each successive interval. These series may be ascending or descending, according as the products grow more or less complex, and an ascending series may be gradually converted into a descending one; but in nearly all cases some *progress* is constantly made in one direction or the other. So far as the history of our globe is known, the phenomena taking place upon it have presented a decided preponderance of ascending series from the remotest periods of which science furnishes any account, and such would also seem to be the case throughout the solar system at large, with exceptions only in the case of some of the smallest bodies, as of the earth's satellite. There has thus taken place a sort of *development* or *evolution*, which in the inorganic world proceeds from a more homogeneous and less differentiated state toward a more heterogeneous state, with greater concentration of parts. In organic nature organization increases, structure is complicated, and the physiological division of functional labor is combined with the integration of differentiated organs and their subordination to large complex organisms.

These are surface truths. A more recondite truth often escapes | detection. These perceptible effects represent only the resultant of multiple causes. Movement 359
is in only one direction, but impact is in all directions. A law which has been called the "instability of the homogeneous" requires that motion shall take place in some one direction, and what that direction shall be must depend upon what, in our ignorance, we are compelled to call chance. The chief fact of interest, therefore, arising out of this dynamic state of nature is the one least observed and

usually quite ignored; it is that the increment in the direction of motion, the algebraic sum of the forces of progression and regression, is, as compared with their arithmetical sum, excessively minute.

Neglecting, for the present, retrogressive tendencies, which presuppose prior progressive ones, and considering all phenomena as only undergoing the latter process, we first observe that the increments of this genetic progress are what may be called *differentials;* that the movement takes place by infinitesimal differences. This is phenomenal or concrete, as distinguished from mathematical or abstract, *differentiation.* The objects moving are in immediate contact with the objects moved; the latter yield only at the instant when the former impinge; the antecedent and consequent are contiguous, and the cause and effect are intimately bound up together.

It is scarcely necessary to state the corollary that in genetic progress the great preponderance of force actually exerted is lost in the work of so nearly maintaining the state of equilibrium. The energy expended in the retrogressive is nearly equal to that expended in the progressive direction. But this is not all. Every object in the universe is exposed to impacts from all sides. The direction of motion is simply the line of least resistance. If we contemplate a progressing body or system we must not only conceive its line of motion as simply that along which the antagonizing impacts are least in amount, but we must also conceive that upon all sides, except that immediately in front and that immediately behind, the impacts, however great, are absolutely equal. These lateral impacts, however, from this circumstance of exactly neutralizing each other, may be neglected, and attention fixed only on the directly impelling and retarding forces. All this is as true of a complicated train of phenomena, such as a sidereal system or a living organism or species, as of a single aggregate or body; and progress in structural development comes as strictly under the law as mere progress in space, since, in a manner, the

former may be analyzed into elements of the latter. This
law may be considered in every depart | ment of natural 360
phenomena, and naturally we follow the steps from
the lowest inorganic to the highest organic stages.

The primary form of inorganic development of which we possess any knowledge is that of world systems. Nearly every one who allows himself to speculate at all now believes that such development has taken place, and that the earth and the solar system are products of dynamic tendencies in the universe. It is proper to call this process and all kindred ones *organization*, since this term merely expresses its true character. The term *evolution* has been applied to it, but in doing this very great confusion has been introduced. According to the laws of the redistribution of matter formulated by Mr. Herbert Spencer, there exist two great antagonistic tendencies, one of which he names Evolution, and the other Dissolution. The former consists in the integration of matter and the dissipation of motion, and the other in the absorption of motion and the disintegration of matter. [First Principles, § 97.] To the first of these he ascribes the formation of world systems and of solid forms of matter. The latter, he admits, is not manifested on a large scale in our quarter of the universe, but is seen on a small scale under the form of heat and its effects. He also attributes the origination and development of organic forms to evolution, and the periodical destruction of organisms to the opposite force. He thus fails to perceive the obvious inconsistency and contradiction which his definitions involve, since he agrees with the popular, but only partially correct, belief that all organic development is due to solar heat. But heat is the normal form which the forces of dissolution always assume, and its effect is always in the direction of disintegrating every form of concentrated matter, and of liberating motion, an effect precisely the reverse of what Mr. Spencer predicates of evolution. In his scheme, therefore, cosmic and organic evolution are due to diametrically opposite forms of force. It would seem that

Mr. Spencer has failed to state, if not to grasp, one of the most important truths involved in his philosophy, viz., that the two antagonistic forces are always interacting, and that progress is due to an excess of the positive element, while retrogression is due to an excess of the negative element. Evolution and dissolution are not forces in themselves, but only the results of the conflict between forces. The true antagonistic forces are those of *gravitation* and *radiation*, and evolution proper, or organization, when it takes place, denotes a certain predominance of the former over the latter. When this principle is once grasped, the apparent inconsistency between cosmic and organic evolu-
361 tion no longer exists, and | we have only to admit, what is the incontestible truth notwithstanding the popular view to the contrary, that the gravitative forces on the globe more than counterbalance the dissolving influence of solar heat, and thus render organic development possible.[1]

These principles have such an important bearing upon the entire law of genetic phenomena that the foregoing brief statement of them seemed not only justifiable, but necessary. In the light of them we may clearly see the nature of genetic progress in the universe of celestial bodies. The unchecked effect of gravitation alone would quickly bring all things to rest in a wholly unorganized state; that of heat, alone, would quickly dissipate all matter into gas, if not into interstellar ether. The preponderance of the latter would effectually prevent symmetrical forms from evolving, while too great excess of the former would rapidly condense the matter of space into heterogeneous and amorphous masses. It is the golden mean between them that secures the true evolution of the orbs of space.

Organic evolution proceeds according to the same general law. The development of any organism consists of a series of wholly inappreciable increments, due to the resul-

[1] I have developed this view somewhat more at length in an article which appeared in the *Popular Science Monthly* for October, 1877, vol. xi, page 672.

tant force in the direction of progress. Here the individual must be wholly ignored, and the species alone considered. Heredity, however, can be relied upon to preserve the identity of all directly descended individuals, so that it is as though one individual were continuous. Minor variations occur during the lifetime of each individual, which are themselves transmitted, producing a steady progress in a given direction. Besides the direct variations due to the actual impacts upon the individual in the line of whose resultant progress goes on, there is also an indirect form of variation which is probably still more potent in producing change, and which Mr. Darwin has denominated "selection." This operates through heredity in the direction of advantage to the organism in the competition for existence. It is under the conjoint operation of these two laws, which Mr. Spencer respectively denominates direct and indirect equilibration, that all the present living organisms have been developed from the lowest forms, or plasson bodies, and these in turn from the inorganic elements. At the head of the organic series stands man, as representing the highest stage reached in the process of evolution.

As in passing from cosmic to organic evolution we saw the con | tinued operation of the same uniform law, so 362
in crossing the boundary which divides organic from superorganic phenomena, the animal from the social world, we are able to trace a single unbroken process. The human races, like living organisms, are some of them in the ascending and some in the descending series. The latter we may for the present disregard, and contemplate human society as, upon the whole, advancing. This advancement, like all forms of development below it, takes place differentially. It is, like the others, the mere resultant of slightly unequal impinging forces on all sides. Neglecting the lateral impacts which equilibrate each other, and considering only the constructive and destructive forces, we find that, while these are both in themselves enormous, the difference between them is very slight. In fact, so slight is it that it is

not constantly in one direction. Even in periods of most rapid development, social progress takes place by rhythmical flows and ebbs. The latter prevail during parts of these periods, which implies that society at these times is losing ground—*i.e.*, that the destructive forces are actually part of the time in the ascendancy. Except in a limited sense, presently to be considered, this is the nature of all the social progress which has taken place thus far.

Such is the general character of genetic phenomena and genetic progress in all departments of nature; the dynamic condition is brought about through infinitesimal increments; the great bulk of the force expended is neutralized in so nearly maintaining the statical condition; there is incessant rhythm destroying at intervals most of the little that has been gained; the effect is in immediate contact with its cause, and exactly equal to it; there is no leverage or unequal advantage in the method of exerting influence, so that only the crudest and most direct results are capable of being reached. When correctly viewed, therefore, and thoroughly understood, the process of nature proves the least economic of all conceivable processes, a fact which the vastness of the scale on which it operates, and the absolute magnitude of the results actually accomplished by it, have in great measure concealed even from the most clear-sighted and thoughtful students of nature.

The bearing of all this upon the more practical problems of political economy, though it will become more apparent after we shall have considered the contrast presented by teleological phenomena, may nevertheless even now be clearly perceived.

The negative school of political economists insist upon
363 nothing so | strongly as that the natural processes of
society be left undisturbed. All attempts to influence the operation of these laws of nature, which they so greatly admire, are deprecated with a warmth which might make

one doubt the sincerity of their avowed faith in their immutability. But these natural processes are neither more nor less than the form which genetic phenomena assume when seen in the superorganic world.

It was once supposed that nature's methods were the most economical ones conceivable, and constituted perfect patterns for men to copy from. It was while this view prevailed in all departments of science that political economy had its origin as such. Since then biologists have abundantly demonstrated the error of this belief, and had sociology been thoroughly grounded in biology, as Comte so justly insisted that it should be, it would have kept pace with the other sciences in rejecting this fundamental error. But this has not been the case, and we find social science writers still lauding the stern economy of nature's laws. That economy, however, consists only in this, that while no measure is adopted which does not at the time produce some result, however slight, the amount of energy expended in producing such result is wholly disregarded, and bears no proportion to the value of the result. Nature acts on the assumption that her resources are inexhaustible, and no amount of expenditure is too great to be made provided any good, however small, be thereby accomplished.

No system is maintained at greater expense than the reproductive; yet consider nature's prodigality in this. The octopus, in order to hold its own, must lay 50,000 eggs; a single sturgeon emitted 921,600 ova at one spawning, as counted by Dr. Buckland; the codfish hatches 1,000,000 young fish each year, that two may survive and the species not become extinct; the oyster spawns 2,000,000 embryos in a season, if all of which could reach maturity two or three individuals might supply the markets of the world. Professor Baird has estimated that an eel may contain at one time 9,000,000 eggs; a nematode was found to hold 60,000,000, and a tape-worm more than 1,000,000,000 ova. Similar facts confront us in the vegetable kingdom, but we need only mention that a single plant of the common mold, *Penicillium crustaceum*, was found to possess 3,200,000,000 spores.

The apparent peace which is supposed to reign in organic nature is highly illusory. Even the vegetation is at war, and the result of that strife is immensely to lower the
364 possible standard of every living | species of plant.[1]
In the animal kingdom the struggle is desperate and unceasing, and the result is not different from that in the vegetable. Not only is the waste of reproductive power enormous in proportion to the amount of life brought forth, but of the latter by far the greater part meets with premature destruction. Animals, as all know, prey upon each other, producing universal and indescribable suffering, and placing every living thing in a state of chronic terror in the midst of its countless enemies. But even this tells less heavily upon the vital energies than does the silent conflict which results from the competition for the means of subsistence. It is here that occurs the greatest waste, if the cost of producing and developing an organism is counted at anything.

That the same laws have operated in the superorganic as in the organic world is too clear for contradiction. Not only the progress out of barbarism into civilization, but the march of civilization itself, has been attended with the same incidents that characterize the development of a species or of an individual. The archæologist digs the remains of extinct civilizations out of the earth in much the same manner as the paleontologist does those of extinct animals and plants. Besides his wars with the elements and with wild beasts, man has been perpetually afflicted by wars with his own kind. *Homo homini lupus*. And yet these wars of men with their surroundings, with wild beasts, and with one another, are the strict analogues of those of the lower forms of organized existence. | Even the silent battle for subsistence has its counterpart in the competitive

[1] For the evidence of this statement, see my article on "The Local Distribution of Plants, etc.," in the *Popular Science Monthly* for October, 1876, vol. ix., page 676.

struggles of industry. The same wasteful methods prevail in society as in the animal and vegetable kingdoms. The natural resources of the earth are squandered with a wanton disregard of the future. The forests are cut down to supply temporary wants, consumed by escaping camp fires, or purposely cleared for tillage, until the habitable portions of the earth are successively transformed into lifeless deserts. The soil is rapidly exhausted by the first occupants, who consider and know only the immediate present. *Après nous le déluge.* The wild animals useful to man are soon extinguished by the heartless destruction of the fertile females and helpless young. Population distributes itself to great disadvantage. Cities grow up with narrow, crooked streets, which must from time to time be widened and straightened at large absolute cost. Filth and disease-germs, due to dense, unregulated population, bring | 365
pestilence and sweep away at rhythmic intervals the excess. Famines come to scale down the ranks of such as have forced their way in during years of plenty. Bitter partisanship everywhere prevails throughout society, the nearly successful effort of each party being to undo what the other has done. Labor and capital, whose dependence upon each other is absolute, are constantly found in open hostility, which greatly reduces the productiveness of both. Exchange of products is largely carried on by redundant third parties, who, through no fault of their own, are allowed to absorb the largest share of the wealth produced. Trade consists to a great extent in unnecessary and duplicated transportation. Wealth is not only distributed unequally, but inequitably. In short, all the functions of society are performed in a sort of random, chance manner, which is precisely the reverse of economical, but wholly analogous to the natural processes of the lower organic world. Great results, it is true, are accomplished, even in society, by these unregulated natural forces. But are they the best possible? The optimistic view leads to stagnation by discouraging effort, while all true progress springs from that restless

skepticism which dares even to question the methods of nature.

SECOND PAPER.

439

TELEOLOGICAL PHENOMENA.

HOWEVER true it may be, and it is wholly true, that the actions of organized beings are the results of mechanical antecedent causes operating through nutrition and organization, there is still a special character inherent in such acts which separates them widely from the class we have considered. This peculiar character is due to the presence of what in its widest sense may be denominated the psychic element. Organized activities, however lowly in origin, are produced primarily in response to *volition* as their immediate antecedent. It is this volition which is genetically determined, as is the organized substance in which it is generated, but from this point the genetic process ceases, and the teleologic process begins. Difficult as might be the task of discovering the exact place where this psychic element historically enters into the phenomena of nature as concrete facts, this difficulty is only the same with the more comprehensive one by which it is embraced, of finding the boundary line between the inorganic and the organic worlds.

Without consuming space, therefore, in a profitless search for these subtile beginnings, we may at once confront the problem of teleological phenomena in general. As remarked in the preceding paper, these phenomena are primarily characterized and distinguished from genetic phenomena by the manifestation of *will* on the one hand, and of *purpose* on the other. These are permanently correlated, so that any action produced by volition must seek an object, and any action performed for an object must have resulted from a conative faculty. Such action differs broadly from purely genetic activity. The very word *action*, which is

scarcely applicable to the latter, suggests to the mind a generic distinction. More closely viewed, the nature of this distinction becomes clear. A volition consists of certain specialized molecular activities taking place in the substance of the brain or central ganglion of the organism. These could only affect genetically the immediately circumjacent molecules. But organization consists essentially in such an economizing of these molecular nerve activities as to enable them | not only to transmit their energy
to distant parts of the organism, but, in doing this, 440
to take advantage of such mechanical principles as the lever and fulcrum, whereby the effect is rendered greater than the cause. The same result is accomplished primarily in a different way, viz., by the conversion of nerve energy into muscular movement. This takes place on some such principle of concentration as that on which atmospheric electricity is now held to be produced.[1] While muscular contraction may really have nothing in common with electrical discharge, the latter at least suggests an analogy which may aid in forming some conception of it.

The essential difference between purely physical and even the lowest form of psychic phenomena consists in the power the latter possess through organization of producing effects both at a distance from, and of a greater value than, the causes themselves. And owing to the absolute correlation mentioned above of will with purpose, and *vice versa*, this is really the fundamental distinction between genetic and teleological phenomena.

[1] Electricity being a purely surface phenomenon, it resides in the outer surfaces of the minute aqueous globules which constitute vapor or cloud. As these globules are solids, and as the solid contents of spheres increase much more rapidly than their superficial areas, the condensation of many of these minute globules into one larger one, as happens when rain-drops are formed, has the effect greatly to diminish the amount of surface, and, if this was fully charged with electricity prior to condensation, it would fail to contain it after condensation. The result must be an electrical discharge of greater or less violence to other objects.

METHODS OF CONATION.

A nearer inspection of the nature of teleological phenomena shows that the class as such admits, and indeed requires, further subdivision. There are two very different methods by which the will directs and secures action on the part of the organism. A term is needed to express this general conception of voluntary action or the action of the conative faculty. For this the somewhat mediæval term *conation*, perhaps not used since Sir William Hamilton, is not only etymologically, but in point of signification as well, strikingly appropriate, and may be revived. The different kinds of volitional action above referred to may therefore be called *methods of conation*. They may be designated respectively as the *direct* and the *indirect* method.

Considered in their most fundamental relations, the primary property by which these two methods are distinguished is that, in the direct method the only mechanical principles employed are those | which the organism itself
441 secures in its own operation, as above described, while in the indirect method the outward acts, as performed by the integrated organism, themselves embody such principles, thus multiplying the disproportion between causes and effects.

THE DIRECT METHOD OF CONATION.

The acts of most animals, and the greater part of those of human beings, proceed no further than this primary psychic stage. They are strictly teleological, since, however direct their movements, they invariably aim at an object, and are actuated by a purpose to obtain it. These actions occupy a strictly middle position between those movements taking place according to the genetic laws of inanimate nature and those performed according to the indirect method of conation. They especially resemble the former in the obvious mechanical connection between the agent and the object, and even the quality of acting through an interval of space is well typified by the action of a magnet. These primary psychic movements also obey the mechanical law of motion in straight lines. The motion is always along the shortest line from the subject to the object. They are performed in obedience to impulses, and constitute what are called by moralists "impulsive," as distinguished from "deliberative," actions. But primarily all actions are thus impulsive, and the more advanced class have only arisen out of a consideration by the developed intellect of the questions of ease and quickness in attaining success. The many remarkable analogies between actions springing from physical desires and the mechanical forces of nature suggest the importance of regarding the former as true forces, and treating them accordingly. Considering human action alone, these desires, emotions, passions and impulses of various kinds that produce this class of actions constitute in reality the *social forces*, and may be controlled, when thoroughly understood, by the same process as physical forces are controlled. Let us take a few illustrations, with a view to examining somewhat more closely their specific character.

The earliest manifestation of the direct method of conation is seen in what is denominated "reflex action." In this the organization of the nervous system is reduced to the simplest form. The terminal fibres of the sensor nerve are brought into contact with the external object, the sensation is conveyed along the nerve to the nearest or only ganglion, which immediately discharges it along the motor nerve to the extremity or part to be moved, and the action takes place. Simple | as this process is, it is more complicated than any form of purely physical movement, 442
and the function of the ganglion, whatever it may really consist in, is in nature of a volition, of which complex process it is the primary form.

When we consider the acts of the lower animals in general we find an abundance of examples of the direct method. Whatever desire predominates in them controls their movements immediately and absolutely. The object desired is directly sought, and, if no obstacles intervene, directly obtained and appropriated. If the object is at a distance, the entire body moves in a straight line toward it. If an obstacle intervenes the motion is usually equilibrated by it, and the animal brought to rest. In so far as obstacles are surmounted by any form of indirection, in so far a transition from the direct to the indirect method is displayed. But natural selection insures, in a manner which we have not space to explain here, the performance of many acts through *instinct* which appear to involve a higher psychic power, but which really do not do so, as may be easily shown by varying the circumstances from their normal character. In the higher mammalia, however, unquestionable applications of the indirect method are frequently made, and the transition in this respect to the higher acts of human beings is not interrupted at any point.

A large part, however, of the acts of men are still of the direct kind, and in them may be noted certain differences of character which enable us to make a convenient, if not a logical, classification of them. The widest distinction which can be observed among them is that between those resulting from *compulsion* and those resulting from *persuasion*. The method most nearly resembling that of animals is that of force, and this is employed by human races in proportion to their intellectual (which is a true measure of their moral) development. Up to a certain point "brute force" is the rule in all forms of acquisition and the gratification of desire. The method of nature is of this kind. Life is an open struggle. The lowest savages, like the wild beasts, recognize no *rights*. What they see and want they proceed directly to seize and appropriate. They succeed if not forcibly prevented by other individuals who, without any more thought of equity, struggle to retain possession. Many men in civilized countries seem to have scarcely progressed beyond this directly coercive stage. What is recognized in human beings as the cropping out of animal propensities is the tendency to move directly upon the objects of their desire, with no delicacy in conforming to the rules of propriety | and decency which civilization has laid down for the government of conduct. 443

There are many human institutions which seek to attain ends by the direct method. War, however much the indirect method may be incidentally employed in its detailed management, is in its *ensemble* essentially a measure of direct coercion. The effects are no greater than the effort required to secure them. The action is exactly balanced by the reaction. The algebraic sum of the result of all wars is *nil*. Government, contrary to what some might suppose, deals chiefly with direct coercion. Not only this, but its influence is mainly negative, or repressive. Nearly all laws are in nature of prohibitions. The penalty for their violation is force; very few command the performance of new actions, and almost none execute themselves, as they would do if they applied the indirect method of conation. Most forms of charity proceed according to the direct method. They simply mitigate present suffering, leaving the causes of it untouched. The motive in this case is sympathy, which, though a later sentiment and a higher one, is no less a physical impulse than hunger or lust. It is by this quality that the current philanthropy is distinguished from true humanitarianism and from *meliorism*, which employ the indirect method.

Turning next to the second class, in which the means are persuasive, instead of compulsory, we find that, while such acts are confined to human beings having attained a considerable degree of development, the results are sterile or feeble to the same extent as in the other class. Most cases of impassioned appeal, of exhortation, and also of command or threat, provided the latter are not, to the knowledge of the individual to be influenced, likely to be followed by physical coercion, belong here, as do all supplications, entreaties and demands unaccompanied by a substantial consideration. It is, therefore, chiefly in the domain of religion and morals that this class of actions occur.

This doubtless accounts to a large extent for the failure of great moral and religious systems to reform the world. Notwithstanding the fact that these have inculcated, throughout all the centuries of human history, the greater part of the fundamental moral truths and principles recognized by the most advanced civilized peoples of the present age, it is claimed by the exhortatory moralists themselves that morals have been continually declining, although the more rational students of history see that this is not the case, but that the real moral progress of the last three centuries in the *élite* of humanity is closely correlated with the growth of the scientific method, the diffusion of knowledge
444 following the invention of printing, and the consequent spread of liberalism in society. Toward it "moral suasion" has exerted no appreciable influence. The cause of this is the same as in those cases in which mechanical force or physical compulsion are employed. Both methods are direct in the sense here used, and from the inherent nature of the direct method, the results actually accomplished, after deducting the energy expended, are necessarily extremely small. They are comparable in this respect only with the effects of genetic action, already explained, which are strictly differential in their character, resulting only in a secular progress along the line of least resistance.

THE INDIRECT METHOD OF CONATION.

Along the line of cosmic progress the otherwise uniform and secular movement has been, as it were, interrupted by a few comparatively sudden advances, which may almost be called leaps. Such was the origin of life, resulting from the chemical formation of the substance protoplasm; and such, again, has been the birth of the rational faculty, by the exercise of which alone the indirect method of conation is capable of being enforced.

The word *reason*, besides being inherently ambiguous, denoting both a faculty and its exercise, is habitually used in a variety of vague, half-meaningless senses, which serve at once to show forth and to perpetuate the loose, inexact nature of all undisciplined thought. It is not, therefore, from pedantic motives that this in itself noble word is here left out of a discussion designed chiefly to elucidate the nature of the faculty it denotes, but in order rather to explain, if not in simpler, at least in more fundamental and elementary, terms what should be implied in speaking of the reason.

Immanuel Kant was the first philosopher to divide the phenomena of mind into two great classes: Sense and Intellect. (*Sinnlichkeit* and *Verstand.*) ["Kritik der reinen Vernunft," S. 52, 82.] This is one of the few purely philosophical deductions of the writers on mind which have been fully confirmed by the added light of science. As it is difficult to say just where sensation is joined to mere vitality, so it is equally difficult to point out the place in the animal series where thought is first coupled with feeling. But fortunately this task is unnecessary here, and it is sufficient for our present purpose to recognize this fundamental distinction as it presents itself in the higher forms of life, and especially in man.

The direct method of conation, which we have been
considering, springs entirely from the first of these 445
great branches of psychic function—from the feelings. The acts employing it proceed from the *desires*, the gratification of which they aim to secure. These desires, whatever their nature or form, constitute, as already remarked, true natural forces, recognizable as such by their obedience to all the fundamental mechanical laws laid down for the physical world.

Motion caused by them is in a straight line, and continues so long as the force (desire) acts, unless checked by a physical barrier. The fly buzzes against the transparent window-pane through wh ch it sees, and continues to do so after further advance is completely checked, even though a few inches above there may exist an open transom. If the direction changes, it must be due to the existence of another force (desire) in a different direction. A savor from the dinner table may furnish a stronger attraction than the external sunlight, and cause the fly to leave the window and descend to the table.

The reaction is equal to the action performed, though here a portion of the former is absorbed by the mechanical properties above described, which reside in the organism. A positive gain to the organism is the result which, though small at any point, increases with the degree of organization.

The importance of recognizing these organic forces will be dwelt upon at length at the proper time. We have now to attend to the great distinction which arises at this point. It is obvious that the effort to gratify desires by the direct method must often fail. Obstacles intervene and bring the forces into equilibrium. Want of correspondence between the organism and the environment leads millions of beings to premature destruction. The moth singes its downy wings in the flame, but still blindly renews its perilous feat till it falls a crisped mass. Heaps of frail ephemera lie lifeless at the foot of every lamp-post of a city after a warm night in May. The American quail (*Ortyx Virginiana*) is trapped in thousands by the simple device of fastening kernels of corn to the ends of strings tied to a common stake. The bird swallows the kernel with a part of the string, but in attempting to escape it finds itself caught. Nothing is easier than to draw the kernel from its crop after it is taken, but this it cannot do for itself. It only knows one way to go from a place of danger, and that is by keeping its head away from the evil spot. In attempting thus to escape, the friction of the string in the angle of the beak prevents the extraction of the kernel. It never reverses
446 this method, and turn | ing its head to the stake pulls backward. This would be instant success, but this would require the application of the indirect method, of which the bird is incapable. *Quae ipse miserrima vidi.*

What, then, is the fundamental character of the indirect method of conation? A single word expresses it: *Invention*. The sole function of the intellect, as an aid to sense, is to invent. It may seem an exaggeration, but in truth this is all that reason ever does. It is the essential quality of the rational faculty, and every higher form of proper thought can be traced back to this primary inception. Let it not be forgotten that the gratification of desire is the sole *desideratum* of life, whether low or high in the scale of being. If this could be fully accomplished by the direct method no other would be needed, no other could have been developed. But with this alone progress must remain extremely slow. To avoid rapid destruction due to lack of correspondence, organisms must be restricted to small local areas and a few uniform environing conditions. The boundaries of every animal's normal habitat is a veritable "dead line" for every individual that chances to overstep it. Man alone has made the entire globe his habitat. He has accomplished this by the application of the indirect or inventive method. He has invented clothing, shelter, fire, weapons, etc., and made himself master of the planet.

But we have thus far only raised a question, not answered one. What is invention? What does the indirect method essentially and intrinsically consist in? It is not more teleological than the direct method; wherein consists, then, its superiority? We do not answer this important question by saying that it is the *artificial*, as contradistinguished from the *natural*, method, but we bring it one step nearer the possibility of solution. The distinction of natural and artificial is not commensurate with that above drawn between genetic and teleological. The term *natural*, besides embracing all genetic phenomena, includes also all the movements of living creatures which result from the organic forces above described. It, therefore, divides off all forms of change below that brought about under the direction of the inventive faculty from those above the origin of this faculty—the blind forces, whether physical or organic, from

the intellectual forces of the universe. Under *natural* phenomena are, therefore, to be classed all the changes that take place in the inorganic world, together with the organic phenomena of *life* and *feeling*. Under *artificial* phenomena there can be classed only those of *thought* or intellection. Genetic changes take place through infinitesimal incre-
447 ments, and are secularly slow, all but a mere differential of energy being lost in equilibration. Vital phenomena belong to the genetic class. Sense phenomena are teleological, but direct, thus securing no mechanical advantage (except such as the organism itself has secured through its structural development) which can render the results produced any greater than the energy expended. Intellectual phenomena, which are also teleological, alone secure this advantage, and it is this which distinguishes all forms of *art*, and constitutes such actions *artificial*. While many such actions are performed by the higher animals, it requires a close discrimination to distinguish them from instinct, which may be denominated *secondary organization*, since it secures through purely genetic methods such cumulative adaptations as are secured by morphological organization, whereby certain mechanical advantages are gained so long as the creature restricts itself to the constantly recurring influences of a circumscribed habitat, but which are as inoperative outside of that habitat as are physiological processes outside of the organism. We may, therefore, disregard all living creatures except human beings. Art may then be defined as *the rational control of natural phenomena so as to bring them into harmony with human advantage*. Originally there is no such harmony. Those optimists who imagine they see it wholly misconceive the nature of the world they live in. The universe is not anthropocentric any more than it is geocentric. Man is as little to this planet as the latter is to the system of which it forms less than one-three-hundred-and-fifty-thousandth part of the matter. All that can be said of the correspondence is that it is great enough to permit man to

exist. But for this he could never have been evolved. But without art his existence must not only be very poor, but confined to a very small part of the globe. The North American Indians, although they possess many true arts, are able barely to maintain a subsistence. The same is true of all savage or barbaric races, especially in temperate or cold climates.

A company of civilized men, desiring to visit even for a short time a region entirely given over to nature, must carry with them copious supplies of various kinds of artificial products, to prevent perishing from hunger and want. Such facts bring forcibly home to the mind, not only the great want of correspondence between man's physical nature and his unimproved habitat, but also the vast extent to which he is absolutely dependent upon artificial objects for his power to subsist in this world.

From this superficial survey we are enabled to
perceive the immense superiority, from the point of 448
view of human advantage, which is the only practical one, of teleological over genetic, and of artificial over natural, processes. Yet, notwithstanding the obtrusiveness of this truth, there is a class of persons who devote their energies to the work of extolling the natural and decrying the artificial. Not to speak of the school of Rousseau, who are merely carried away by the charms of an idle life in the midst of nature, but which they could never have appreciated or enjoyed but for the previous culture and artificial preparation they received, there are eminent men of science who affect, or perhaps really feel, a sort of contempt for artificial objects, and especially for artificial methods of every kind. They urge the imitation of Nature in all things, and especially insist that no ruthless hand of man shall be laid upon her alleged perfect products or processes. Everything that Nature produces, as well as the manner in which she operates, is regarded as in some respect greatly superior to the artificial, and, as it were, almost sacred. In fact, this sentiment in some seems to take the form of a sort of *nature-*

worship, of which primitive savage religion it may perhaps be regarded as a modified survival. Singularly enough, these modern physiolaters are among the most eminent teachers of science and philosophy, and might be supposed to be aware of the true relation which science bears to art. It would be tautological to say that all art must be artificial, but it is less obviously so to express the same truism by saying that all that civilized man regards as possessing value has resulted from the control—*i.e.*, the "violation"—of natural laws. It is by artificially directing the otherwise random and useless, or harmful forces of nature into channels of human advantage that all wealth is created, and the very means to the further prosecution of science obtained. But, most incongruous of all, we find that it is the same class of scientists who most strenuously insist upon the uniformity of the higher psychic and social phenomena and the consequent scientific character of these complex, as well as of the simpler, domains of force, who specially deprecate any artificial interference with the natural operation of these forces, and declare that if left to themselves they will work out all the problems of civilization in their own good time and way. The truth is that Nature is no more anthropocentric in these higher fields of phenomena than in the lower ones, and there is no more probability that the psychic and social forces, left to themselves, will ever secure any truly grand results in civilization than there is that the
449 physical forces would, without inventors, have evolved the steam engine or the spinning jenny. But when we reflect, in connection with the immense results which art has wrought in these lower fields, that the higher ones are as yet comparatively untouched, there is at least room to hope that, when they shall receive their proper share of attention, corresponding improvements will be made whose value will be as much greater as the phenomena controlled are higher and more practical in their character.

With this outline of the subject we may now approach the central problem as to the exact nature of that form of action which we have called indirect, and which underlies all art and constitutes the essence of invention. That it consists in the intelligent control of natural forces and their subjection to man's service is clear, and it only remains to consider the precise *modus operandi* by which this is accomplished. All the matter of the universe is perpetually in motion, and its varied movements are constantly conflicting with each other and influencing each other in obedience to the known laws of the impact of bodies. These influences are known as the forces of nature. Taking the universe as a whole, these forces are supposed to balance each other, but in no one part of it do they do so at any time. The secular dynamic phenomena which we call cosmic and organic, or even social progress, represent simply the difference between these forces acting upon certain objects in comparatively restricted localities. These forces are, as compared to human strength, very powerful. Were the sinister ones not antagonized by the friendly ones, man would be instantly swept out of existence. Naked resistance to such influences is almost imperceptible, and the human, like other lower organisms, has been thus far little more than carried along between these mighty opposing forces. In all this, as already remarked, there is no conscious concern visible for the fate or welfare of any created thing. An earthquake is as liable to swallow a populous city as an equal area of Saharan sand. If, on the other hand, these forces chance to operate favorably for human welfare—*i.e.*, if the line of least resistance among all the antagonizing forces happens to coincide somewhat closely with that of human advantage—great and rapid progress may take place. It is very obvious that if any considerable part of the influences which now oppose human progress, or of those which so antagonize each other as to be without effect upon it, could be made to coincide with its direction, great benefit would result. Or, if any of those which now so nearly | equilibrate the existing progressive tendencies could be removed or turned away, this would leave the 450 former free to act, and would produce the same result. To bring about either one of these three effects is the essential work of invention. By the direct method this could only be attempted by attacking physical force with muscular force. Against such enormous odds man's puny arms are relatively powerless. But by the indirect method muscle is employed only to execute some comparatively trivial adjustments, by which, however, as foreseen by the intellectual faculty, these physical forces are effectually directed into the required channels, and either made to perform the work which man desires or to cease to antagonize existing friendly forces, or even to do both these things at once, being thus converted from hostile to auxiliary influences. Such results are often accomplished with the greatest ease after the mode of doing them has been once learned, and there seems to be no necessary limit to the extent to which they may be carried. But, simple as many inventions may appear, let it not be forgotten that the very simplest require reason acting upon a certain correct acquaintance with the laws of natural phenomena.

The practical result of this exercise of intellectual effort is to render the subsequent muscular effort small in proportion to the result produced. There is no fixed ratio between cause and effect under the operation of the indirect method; it may have any value, from that which the mere momentum of a club or a stone offers over the naked hand in a combat, to that which the blowing up of Hell Gate represents as contrasted with the gentle movement of a child who applies the fuse.

All objects on the surface of the earth, though supposed to consist of molecules which are moving among themselves, and though known to be undergoing secular changes, and destined to manifest, sooner or later, wholly different forms without human agency, may, nevertheless, so far as man's daily dealings with them are concerned, be regarded as in a state of repose or inertia. The forces of gravitation and

chemical reaction have reduced them to a state of equilibrium. Though differing immensely in properties, in form, size, consistency, etc., they are most of them in so far tangible that they allow their relations to be changed at the hands of man. In short, they neither escape him nor resist him, nor refuse to be subdivided, modified in form, or transported in space. Before the active efforts of man, the objects of nature are wholly passive. The condition which they have naturally assumed is the | statical one. The
free forces of nature have already played upon them 451
in antecedent dynamic states until they have at last been reduced to their present state. This is the one in which they are capable of producing their minimum effect upon surrounding objects. While their matter has been integrated, their motion has been dissipated until the matter and force of the universe, at least of the part of it which man occupies, have, as it were, become divorced, and exist and manifest themselves independently; at least, such is the apparent, and, so far as human action is concerned, the practical, condition.

Now it would be reasonable to suppose that, since natural objects have been constantly borne down until they have been brought to assume the greatest degree of stability of which they are capable in the existing condition of the universe, any attempt to disturb that condition must remove them more or less from that stable state, and render them less inert and less indifferent to the influence of the free forces still playing upon them. Such is, in fact, the case, and it is an indisputable truth that the great results achieved by man in operating upon the material objects of the earth have consisted in removing these objects from the still folds of material death in which he has found them, and in so placing them that the surrounding influences which originally consigned them to this state can again set up changes in them, and, as it were, reanimate them. In scientific phrase, it is by the transfer of material objects from the statical to the dynamical state, from a condition of molar rest to one of molar activity—the conversion of molecular into molar energy—that human civilization has been able to originate and to advance.

But this is a work which mere natural forces, whether mechanical, vital, or social, would never know how to undertake. It is only under the guidance of the intellectual faculty that the first step in this direction can be taken. The means necessary to be employed differ so widely from the ends that intellectual foresight can alone insure their adoption even in the simplest cases. The acts really required are so wholly unlike those which would be required if the end were directly sought that a highly developed rational faculty is demanded in all beings that are capable of performing them. When a being, endowed with desires to be satisfied, is made acquainted with the existence of a desirable object, it is immediately prompted to move, or put forth efforts in the direction of that object. To such a being, another, desiring the same object, that should turn away from it and commence making adjustments in other objects lying about, would, to use the | language of
452 fable, appear extremely stupid. Such action would be declared *unnatural;* in fact, it would be *artificial.* If really adapted to secure the end in view, unattainable by direct effort, it would be a legitimate exercise of true art, involving, as all art involves, an acquaintance with certain laws of nature, which is the essence of science itself.

The one principle common to all forms of art and invention is that of causing natural forces themselves to do the work that man desires to have done. There are, however, many ways in which this principle may operate, in some of which the principle itself is somewhat difficult of detection. On the basis of these differences the modes of invention or the kinds of indirect action admit of a rough classification. The largest groups in this classification are those that concern respectively the *amount* and the *direction* of force. In the former case, friendly forces are intensified and hostile ones diminished. In the latter, neutral forces, or even hostile ones, are turned to beneficial purposes, or the latter are rendered neutral. Where friendly forces are intensified, or any forces made useful or more useful than before, the invention is *positive*. Where hostile forces are either diminished or diverted, the invention is *negative*. To simplify the problem we need consider only positive invention. The principle of *intensification* is exemplified by the lever and fulcrum. As has been well established, this principle extends to embrace the inclined plane, the pulley, and the wheel and axle. This law, therefore, really underlies all strictly mechanical art. The principle of *direction* is well illustrated in the simple art of irrigation, which was practiced by the American aborigines in the Lower Status of Barbarism. The neutral force which was carrying the mountain torrent down to the sea was, by a simple device, made to carry it to the fields of maize. There is a further law of *commutation*, which has been extensively employed, and which may sometimes be brought under one and sometimes under the other of the general divisions above defined. Thus, time is often commuted or converted into force, as in raising a pile-driver, intensity and consequent effect being secured, not by a mechanical principle, but by distribution of force over a greater interval of time. The reverse of this, or a negative principle, is seen in the phenomena of weights and springs to operate clock-work. Many other subordinate laws might be noted.

We may now take leave of the general subject of the Classification of Phenomena, but before doing so we may profitably present the results thus far reached in the foregoing discussion in a more con | densed form, to
which the reader can readily refer. This object we 453
have endeavored to accomplish in the following synoptical table:

PHENOMENA ARE:

Genetic; physical; unconscious; producing change through infinitesimal increments.

Teleological; psychical; conscious; proceeding from volition and involving purpose.

Inorganic; the result of physical or mechanical forces.

Organic; the result of vital, vegetative or biological forces.

Direct; proceeding according to the Direct Method of Conation.

Indirect; proceeding according to the Indirect Method of Conation.

Animal; as manifested by creatures below man.

Social; as manifested in human Society. Domain of the Social Forces.

Natural; taking place according to uniform laws which may be known, and due to true natural forces, the effects of which may be foreseen, and the phenomena modified or controlled.

Artificial; as modified, directed and controlled by the intellectual faculty.

122. Darwin as a Botanist

History.—Written May 7–12, 1882. Delivered as one of the addresses at the Darwin Memorial Meeting of the Biological Society of Washington, May 12, 1882. The death of Charles Darwin occurred on April 19, 1882. The Biological Society of Washington held a Darwin Memorial Meeting on May 12th. The addresses of Messrs. Gill, Dall, Powell, Riley, Baker, True, and myself covered the greater part of his vast field of scientific activity.

Proceedings of the Biological Society of Washington, with the Addresses read on the Occasion of the Darwin Memorial Meeting, May 12, 1882. Vol. I, November 19, 1880, to May 26, 1882. Washington, 1882, pp. 81–86.

APPOINTED by the committee to furnish a brief sketch on this occasion of the contributions of Charles Darwin to the science of plants, I have purposely chosen the title "Darwin as a Botanist," in order to emphasize the contrast which may be drawn between different classes of botanists, and to do what I can to accustom the public mind to associate with the terms *botanist* and *botany* certain great fields of investigation which are now rarely suggested by these words.

If I had entitled my paper Darwin's researches into the phenomena of the vegetable kingdom, I fear it might not have occurred to some of you that this great investigator was a botanist, as he is not generally known as such. Yet I fail to see why the science of botany is not fully entitled to receive its share of the dignity and the lustre which Darwin's investigations have reflected upon biology in general.

The popular idea of botany, however, is very different from this. Not ignorant people entirely, but scientific men as well, place all botanists under two general classes: "Field Botanists" and "Closet Botanists."

The field botanist is one who, being passionately fond of plants and having mastered the rudiments of botany and become familiar with the names and classification of plants, searches the country for new and rare species, and for new localities for old ones, and makes large collections. Success in these objects is his triumph, and occasionally becoming the proud discoverer of hitherto unknown forms of vegetable life, he finds the scientific world quick and generous in awarding him due credit.

The closet botanist is one who, disdaining the boyish pursuit of flowers, devotes himself to the study of the characters of plants as revealed by the herbarium specimens
82 which the field botanist so | copiously furnishes, and by which method he, too, can discover "new species," and obtain prompt recognition.

The closet botanist performs the further useful service of "revising" intricate families and genera of plants, unraveling the entanglements of previous authors, and making such changes in the classification and names as are best suited to secure the maximum personal credit.

I need not tell this audience that Charles Darwin belonged to neither of these classes of botanists. A lover of nature, he yet never wasted precious time in the idle pursuit of rarities. Thoroughly familiar with the distinctive characters upon which botanical classification rests, he yet never pursued to any marked extent the investigation of specimens from the *hortus siccus*. I doubt whether a single species of plant was ever named after him by reason of his having either discovered it in a wild state, or detected its specific distinctness by the examination of its characters. I even doubt whether he possessed a herbarium, in the accepted sense of the word.

And yet this man has probably contributed more to our real knowledge of plants than any other single botanist.

In what, then, have Darwin's botanical investigations consisted?

There is a little French book entitled "Voyage d'un Botaniste dans sa Maison," a title which, allowing for the characteristic hyperbole of the French tongue, suggests the general nature of Darwin's botanical studies. His researches were conducted in his laboratory, in pots of plants at his window, in his aquarium, in his green-house, in his garden. He worked with instruments of precision, recorded his observations with exactness, and employed every mechanical device for making his results reveal important truths, of which the genius of man would seem to be capable.

Darwin looked upon plants as *living things*. He did not study their *forms* so much as their *actions*. He interrogated them to learn what they were *doing*.

The central truth, towards which his botanical investigations constantly tended, was that of the universal *activity* of the vegetable | kingdom, that all plants *move* and *act*.
He has, so to speak, *animated* the vegetable world. 83
He has shown that, whichever kingdom of organic nature we contemplate, to *live* is to *move*.

He blandly rebukes the vulgar notion that "plants are distinguished from animals by not having the power of movement," and still more modestly says that "plants acquire and display this power only when it is of some advantage to them." But is this the whole? Do animals display this power except when it is of some advantage to them? Certainly not.

Darwin shows us that certain parts of all plants are at all times in motion; not merely the molecular activities of their tissues and of the living protoplasm in their cells, but organized movement of parts. Every leaf, every tendril, every rootlet, possesses the power of spontaneous movement, and under nearly all circumstances actually exercises that power.

There are a great many distinct kinds of movement, depending in all cases upon the special advantages thereby gained to the plant. The laws under which these movements take place have received from him an admirable terminology. Most of them are conditional either by light, by gravity, by radiation, or by insect agency.

We thus have of the first class, *heliotropism*, or movement towards the light; *apheliotropism*, or movement from the light; *diaheliotropism*, or movement at right angles to the source of light; and *paraheliotropism*, embracing such movements as screen the plant from excess of light.

To the second class belong: *geotropism*, or movement towards the earth or into the soil; *apogeotropism*, or movement contrary to the force of gravity; and *diageotropism*, or movement at right angles to the force of gravity.

The third class embraces the so-called *nyctotropic* movements of plants by which they appear to sleep, and which prove to be devices for the prevention of excessive radiation of the plant's heat.

Under the fourth class fall all those wonderful movements which aid the plant in preventing self-, and securing cross-
84 fertilization, a | subject of the most absorbing interest, and of which you have already listened to so able a presentation by Prof. Riley from the point of view of the entomologist.

But Darwin's great service has been to show that these varieties of activity are simply modes in which inherent and spontaneous activities manifest themselves under these varying external influences.

His preliminary investigations into the nature of these innate powers of movement were directed to that large class of plants known as twiners and climbers, whose revolving motions were so thoroughly described in his work on "Climbing Plants." It was here that he laid the foundation for those later studies which eventually resulted in that great work, almost his last, on the "Power of Movement in Plants." In this work he demonstrates by an enormous induction that the ample sweeps of the twining plant are but the most obvious manifestations of a class of phenomena which are common to the entire vegetable kingdom.

Amid the varied forms of movement which plants present Darwin has succeeded in finding one fundamental and generic one to which every other may be referred. To this universal form of plant activity he gives the name "circumnutation." Not only twining stems and tendrils, but parts of flowers, tips of growing shoots, caps of penetrating roots and rootlets, radicles, epicotyls, cotyledons, and even full-grown leaves, are incessantly describing circles, ellipses, and other more or less regular geometrical figures; and he conclusively shows that it is out of this primary form of activity that all the more specialized forms already mentioned have been developed. All movements of the parts of plants are thus to be interpreted as modified forms of this innate periodic circumnutation which is common to all plant life. Such modifications are always in the direction of the plant's advantage and may be so great as to become difficult of recognition as forms of circumnutation.

I need not labor to convince you that any modification which is an advantage to the plant will be secured by the process of natural selection. It is the glory of the
great genius whose labors we are | here to commemo- 85
rate to have demonstrated this truth to the entire satisfaction of the united scientific world.

Darwin has actually solved the great problem of phytology, so long admitted to be incapable of solution, viz., Why does the root grow downward and the stem upward? Briefly and roughly stated, the answer to this question is that as the bursting seed pushes out its two germinal points these circumnutate from the first, and thus explore their surroundings for the means of benefiting the plant. To employ Darwin's own word, they "perceive" the advantage that would result from the penetration of the soil, on the one hand, and from the ascent into the free air and sunlight, on the other, and through the pre-Darwinian law of the "physiological division of labor," one becomes *geotropic* and the other *heliotropic*—the one develops into a radicle and then into a root, while the other develops into an epicotyl and then into a stem.

I will only add to the thoughts already presented that Darwin's discovery of the existence in all plants of an innate and spontaneous mobility belonging to them as forms of organic life, possesses an important ulterior significance.

The law of natural selection, as a fundamental process, has long since passed the stage of discussion. But there has always remained one unsettled question lying at its very base which Darwin himself admitted to be an open one. That question concerns the cause itself of variation. It is granted that, admitting the *tendency to vary*, all the results claimed for natural selection must follow; but many declare that, in this very tendency to vary, there is a mystery as great as the mystery of life itself.

It is only in this work on the "Power of Movement in Plants" that Darwin has really assailed this last fortress of supernaturalism. Not that he has avowed any such purpose, for of this he would have been incapable, but so skilfully and so powerfully has he marshaled the facts that the conclusion follows without being stated. No one can doubt that he perceived this, and I, for one, am convinced that he saw it from afar, and that it was the great end of his labors;
86 but with his characteristic wisdom he has declined to invoke the *odium theologicum*, correctly judging that the truth must ultimately assert itself.

The tendency to vary, then, is a mechanical result of the proved fact of universal movement coupled with the admitted law of natural selection. By means of the former all plants and growing parts of plants are perpetually exploring their immediate surroundings in search, as it were, for conditions favorable to development. By means of the latter they are able to avail themselves of such favorable conditions when found. Nothing further than this is required to complete the natural explanation of all the phenomena presented by the organic world, and thus, at last, the whole domain of biology is emancipated from teleological fetters, and placed on the high plane of rational investigation.

In conclusion, let me simply say that, while we can but deeply mourn the irreparable loss which science has sustained in the death of Charles Darwin, we have still the highest grounds for congratulation in the fact that he lived to complete that great work which, next to the "Origin of Species," will, I firmly believe, be awarded by posterity the highest place, viz., "The Power of Movement in Plants"; for, while the former auspiciously opened the great debate by stating the profoundest of all biological problems, the latter has fittingly closed the argument by answering the last objection.

123. Catalogue of a Collection of Japanese Woods Presented to the United States National Museum by the University of Tokio, Japan

History.—Old names verified, unlabeled specimens identified, and list made out May 19 to June 11, 1881. Dr. Vasey assisted me in identifying the unnamed material.

Proceedings of the United States National Museum, Vol. IV, Washington, 1881, pp. 308–311.

THE collection of woods recently presented to the National Museum by the University of Tokio, a catalogue of which is herewith presented, has been prepared in a very unique and artistic manner. Each kind of wood is represented by a polished panel about 9 by 12 inches in dimension, upon which are painted, in color, accurate delineations of the leaves, flowers, and fruit of the tree. Each panel is framed between strips of wood sawn from the outer portion of the tree, and covered with bark provided with corner pieces, which are round blocks cut transversely from branches an inch or more in diameter. The catalogue of this collection has been prepared by Mr.

Lester F. Ward, who has supplied the modern approved names for such species as are labeled with the older synonyms. In a few cases no authority could be found for the name given, while in others the species are not named and have been provisionally determined.

MAGNOLIACEÆ.

1. *Illicium anisatum*, L.
2. *Magnolia hypoleuca*, Sieb. & Zucc.

BIXINEÆ.

3. *Idesia polycarpa*, Maxim.

TERNSTRŒMIACEÆ.

4. *Eurya Japonica*, Thunb.
5. *Stuartia monadelpha*, Sieb. & Zucc.
6. *Camellia Sanagua*, Thunb.
7. *Camellia Japonica*, L.

MALVACEÆ.

8. *Hibiscus Syriacus*, L.

TILIACEÆ.

9. *Tilia Mandschurica*, Maxim.

RUTACEÆ.

10. *Xanthoxylum piperitum*, DC.
11. *Citrus trifoliata*, L.
12. *Citrus vulgaris* (?), Riss.

SIMARUBEÆ.

13. *Picrasma ailanthoides*, Planch.

309 MELIACEÆ.

14. *Melia Azedarach*, Adans.

ILICINEÆ.

15. *Ilex Sieboldi* (?).
16. *Ilex integra*, Thunb.
17. *Ilex crenata*, Thunb.

CELASTRINEÆ.

18. *Euonymus Sieboldianus*, Blum.

RHAMNEÆ.

19. *Zizyphus vulgaris*, Lam.
20. *Hovenia dulcis*, Thunb.

SAPINDACEÆ.

21. *Æsculus turbinata* (?).
22. *Sapindus Mucorossi*, Gaertn.
23. *Acer palmatum*, Thunb.
24. *Acer spicatum* (?), Lam.

ANACARDIACEÆ.

25. *Rhus semialata*, Murr.
26. *Rhus succedanea*, L.
27. *Rhus vernicifera*, DC.

LEGUMINOSÆ

28. *Sophora Japonica* (?), L.
29. *Gleditschia Sinensis*, Lam.
    [*G. Japonica*, Lodd.]
30. *Albizzia Julibrissin*, Durazz.

ROSACEÆ.

31. *Prunus Persica*, Benth. & Hook.
 [*Amygdalus Persica*, L.]
32. *Prunus Mume* Sieb. & Zucc.
33. *Prunus Ssiori* (?), Fr.
34. *Prunus Japonica*, Thunb. (1).
35. *Prunus Japonica*, Thunb. (2).
36. *Prunus pseudo-cerasus*, Steud.
37. *Prunus subhirtella* (?).
38. *Pirus Chinensis*, Roxb.
39. *Pirus communis*, L., [var. *Sinensis?*].
40. *Photinia Japonica*, Benth. & Hook.
41. *Photinia glabra*, Maxim.

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CORNACEÆ.

42. *Cornus officinalis*, Sieb. & Zucc.
43. *Cornus brachypoda*, C. A. Mey.

CAPRIFOLIACEÆ.

44. *Sambucus racemosa*, L.

EBENACEÆ.

45. *Diospyros Kaki*, L.
46. *Diospyros Lotus*, L.

STYRACEÆ.

47. *Styrax Japonicum*, Sieb. & Zucc.

OLEACEÆ.

48. *Olea Aquifolium*, Thunb.
49. *Olea fragrans*, Thunb.
50. *Ligustrum Ibota*, Sieb. & Zucc.
51. *Ligustrum Japonicum*, Thunb.

SCROPHULARINEÆ.

52. *Paulownia imperialis*, Sieb. & Zucc.

GESNERACEÆ.

53. *Didymocarpus Japonicus*, Benth. & Hook.
[*Rotlera Japonica*, Spreng.]

VERBENACEÆ.

54. *Vitex cannabifolia*, Sieb. & Zucc.
55. *Clerodendron trichotomum*, Thunb.

LAURINEÆ.

56. *Cinnamomum Loureirii*, Nees.

ELÆAGNACEÆ.

57. *Elæagnus pungens*, Thunb.

URTICACEÆ.

58. *Zelkova acuminata*, Planch.
[*Planera Kaki*, hort.]
[*Zelkova Keaki*, (?).]
59. *Celtis Sinensis*, Pers.
60. *Aphananthe aspera*, Planch.
61. *Morus alba*, L.

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JUGLANDEÆ.

62. *Juglans Sieboldiana*, Maxim.
63. *Juglans Mandchourica*, Maxim.
64. *Pterocarya rhoifolia*, Sieb. & Zucc.

CUPULIFERÆ.

65. *Alnus maritima*, Nutt.
66. *Alnus incana*, L.
67. *Quercus dentata*, Thunb.

68. *Quercus glandulifera*, Blume.
69. *Quercus serrata*, Thunb.
70. *Quercus glabra*, Thunb.
71. *Quercus acuta*, Thunb. (1)
72. *Quercus acuta*, Thunb. (2)
73. *Quercus glauca*, Thunb.
74. *Quercus cuspidata*, Thunb.
75. *Castanea vulgaris*, Lam.

SALICINEÆ.

76. *Salix Burgeriana* (?).

CONIFERÆ.

77. *Thuya squarrosa*, Benth. & Hook.
    [*Retinospora squarrosa*, Sieb. & Zucc.]
    [*Thuyopsis squarrosa* (?).]
78. *Thuya orientalis*, L.
    [*Biota orientalis*, Don.]
79. *Thuya obtusa*, Mill.
    [*Retinospora obtusa*, Sieb. & Zucc.]
    [*Chamæcyparis obtusa*, Endl.]
80. *Thuya pisifera*, Benth. & Hook.
    [*Retinospora pisifera*, Sieb. & Zucc.]
    [*Chamæcyparis pisifera*, Endl.]
81. *Thuya plumosa*, Benth & Hook.
    [*Chamæcyparis*, sp.]
82. *Cryptomeria Japonica*, Don.
83. *Torreya nucifera*, Sieb. & Zucc.
84. *Ginkgo biloba*, L.
85. *Pinus Koraiensis*, Sieb. & Zucc.
86. *Pinus parviflora*, Sieb. & Zucc.
87. *Pinus densiflora*, Sieb. & Zucc.
88. *Pinus Thunbergii*, Parlat.
89. *Abies firma*, Sieb. & Zucc.

PALMACEÆ.

90. *Chamærops excelsa*, Thunb.

124. List of Water Plants for Carp Ponds

History.—Prepared April 26 to May 24, 1882.

Bulletin of the United States Fish Commission, Washington, D. C., Vol. II, 1882, pp. 22–25.

[The following list embraces only such plants as were named in a list furnished by Mr. Rudolph Hessel, Superintendent of the Carp Ponds. The names given in that list where obsolete are placed in parentheses, the modern ones standing before them. The vernacular name of each is added whenever it is known, and the localities of the American species are given according to the best authorities. When found in the vicinity of Washington the particular locality is mentioned. In the case of exotics the general region of the globe is stated.]

RANUNCULACEÆ.

Crowfoot family.

Ranunculus aquatilis, L.—White Water-Crowfoot.

The type is rare, but the var. *trichophyllus*, Gray, is common in the United States. The var. *heterophyllus*, DC. (*R. heterophyllus*, Weber), is chiefly a European form.

Ranunculus multifidus, Pursh. (*Ranunculus fluviatilis*, Bigel).—Yellow Water-Crowfoot.

East New England to South Pennsylvania, Illinois, and Northwest.

Caltha palustris, L.—Marsh Marigold. Cowslips.

Common North and West.

NYMPHÆACEÆ.

Water-Lily family.

Cabomba Caroliniana, Gray. (Not in original list, but known to be in the carp ponds. Probably wrongly named.)

Florida to North Carolina and westward.

Nymphæa odorata, Ait.—Sweet-scented white Water-Lily.

Found at Great Falls and below the Long Bridge. Common in the Northern States.

Nymphæa tuberosa, Paine.—Tuber-bearing Water-Lily.

Western New York to Michigan, Illinois, and probably in the Southern States.

Nuphar luteum, Smith.—Smaller yellow Pond-Lily.

Chiefly European; the var. *pumilum*, Gray (*N. pumilum*, Smith), is not rare northward in the United States.

HALORAGEÆ.

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Water Milfoil family.

Myriophyllum.—Water-Milfoil.

Six species are found in the Northern United States, of which *M. spicatum* is the most common, and occurs sparingly near Washington.

Hippuris vulgaris, L.—Mare's Tail.

New York to Kentucky and northward; rare in the United States; more common in Europe.

ONAGRACEÆ.

Evening Primrose family.

Trapa natans, L.
Europe, Siberia.

UMBELLIFERÆ.

Parsley family.

Œnanthe sarmentosa, Presl. (*Phellandrium aquaticum*, L.).
Oregon and Washington Territory.

PRIMULACEÆ.

Primrose family.

Hottonia inflata, Ell. (*H. palustris*, Pursh.).—Featherfoil.
Massachusetts to Louisiana.

LENTIBULARIACEÆ.

Bladderwort family.

Utricularia vulgaris, L.—Bladderwort.
Throughout the North and West.

POLYGONACEÆ.

Buckwheat family.

Polygonum (*amphibium*, L. ?).— Water Persicaria.
Common. Has been sparingly found near Georgetown, D. C.

CERATOPHYLLACEÆ.

Hornwort family.

Ceratophyllum demersum, L.— Hornwort.
Abundant.

ARACEÆ.

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Arum family.

Acorus calamus, L.—Sweet Flag. Calamus.
Common.

LEMNACEÆ.

Duckweed family.

Lemna trisulca, L.—Duckweed. Duck's-meat.
Widely diffused.

Lemna minor, L.
America and Europe.

Lemna gibba, L.
Chiefly in Europe, but has been found in Arizona.

TYPHACEÆ.

Cat-tail family.

Typha latifolia, L.—Cat-tail Flag.
Very common.

Typha angustifolia, L.—Narrow-leaved Cat-tail.
Less common, but found in this District and notably in a pond near the foot of Eighteenth street.

NAIADACEÆ.

Pond-weed family.

Potamogeton natans, L.—Pondweed.
Common.

ALISMACEÆ.

Water-Plantain family.

Alisma natans, L.—Water-Plantain.
Europe, Siberia.

Sagittaria variabilis, var. *latifolia*, Eng. (*Sagittaria latifolia*, Willd.).—Arrowhead.
Common.

Butomus umbellatus, L.
Europe; Northern Asia.

HYDROCHARIDACEÆ.

Frog's-bit family.

Anacharis Canadensis, Planchon. (*Elodea Canadensis*, Michx.).—Water-weed.
Common.

Vallisneria spiralis, L.—Tape-grass; Eel-grass.
Common.

IRIDACEÆ.

25 Iris family.

Iris pseudacorus, L.
Europe; Siberia.

JUNCACEÆ.

Rush family.

Juncus effusus, L. (=*J. conglomeratus*, L.).—Common Rush.

CYPERACEÆ.

Sedge family.

Scirpus lacustris, L.—Bulrush. Tule.
Common.

GRAMINEÆ.

Grass family.

Zizania aquatica, L.—Indian Rice. Water Oats.
Potomac Flats, &c.

Glyceria aquatica, Smith.—Reed Meadow-grass.
Common northward.

Glyceria fluitans, R. Br.
Common, but has not been found nearer Washington than Great Falls.

Festuca fluitans, Leeds.
Europe.

Phragmites communis, Trin. (*Arundo Phragmites*, L.).—Reed. Cane.

CRYPTOGAMIA.

Azolla Caroliniana, Willd.
New York to Illinois and southward.

[Remarks made and abstracts of papers read at various meetings of the Anthropological Society of Washington, from February 10, 1879, to January 17, 1882, as published in Vol. I of the Transactions of the Society.

In each case, even in the very brief remarks, I have endeavored to give a name to the thought or idea expressed. To distinguish these descriptive names from actual titles of papers, I enclose them in brackets.]

November 13, 1882—Ætat. 41.

125. [On the Elimination of Unnecessary Grammatical Formalities]

History.—Remark on the paper of Mr. Henry L. Thomas, "On Some Peculiarities in the Use of Moods in the Principal Neo-Latin Languages," read Feb. 15, 1881.

Transactions of the Anthropological Society of Washington, Washington, D. C., Vol. I, pp. 30–31.

MR. WARD was interested in the cases adduced in Latin of the dependent interrogative with the indicative, which appears to be chiefly used in colloquialisms, showing that the common people were disposed to eliminate unnecessary grammatical formalities.

31 | He also alluded to the complicated character of savage and barbaric languages, and regarded this tendency towards simplification as constituting a true progress towards practical economy in speech.

November 13, 1882—Ætat. 41.

126. [On Male Sexual Selection]

History.—Remarks on the paper of Dr. A. F. A. King on "The Evolution of Marriage Ceremonies and its Import," read May 1, 1881.

Ibid., pp. 37–39.

MR. WARD made some remarks on the portion of the paper which referred to the great difference between the sexual habits of human beings and of animals. He applied to the phenomenon as mani|-
fested by man the term "male sexual selection" which 38
he put in contrast with sexual selection proper as described by Darwin, and which is female sexual selection. This last he claimed was in turn due to natural selection, and the chivalrous deportment of male animals towards the females, which alone enabled the latter to select, had resulted from the natural selection of those species displaying it most by the inevitable extermination of those that sought gratification by force after the manner of uncivilized man. He regarded male sexual selection as a purely psychological phenomenon, and due to the influence of the mind in bringing about changes in the sexual habits of the human female. Both sexes becoming rational through the development of the brain, the male learned by various manifestations of cunning to influence the female in the direction of overcoming the apathies and aversions which nature gives her as a protection to her sex. Man appealed to woman's imagination and to her reason, faculties wanting in the lower animals; through appeals to her imagination he was gradually able to excite sexual feeling in her at times when pure instinct forbade it; through appeals to her reason he was able to secure submission at such times in exchange for other favors which he could

confer and of which she in her subject state stood in great need. Even sexual caste, and the reverence of the women for the men, by which the latter further secure the submission of the former at unnatural periods, is possible only to beings with developed mental faculties. In these and other ways a complete revolution in the sexual nature of woman had been produced. It must have taken place as gradually as cerebral development itself, otherwise adaptation would have been impossible. By it men, instead of being chosen by women, became the choosers of their wives, and female, had been converted into male sexual selection. Remarkable morphological changes had been the result, and just as in animals under female sexual selection male beauty had been produced, so in man under male selection female beauty had become predominant. He remarked upon the scarcity of scientific data on this
| important question, and thought that medical men
39 and biologists should take up and prosecute the investigation of comparative ovulation, menstruation, and sexual physiology.

127. Politico-Social Functions.—Abstract

History.—The paper appeared in full in the *Penn Monthly* earlier than the first volume of the Transactions of the Society and the history is given there (see No. 113, Vol. II), but this abstract was carefully prepared for the Transactions soon after it was read, March 15, 1881, and has its value as an attempt to condense the subject into smaller compass. My error in supposing that "Sociocracy" was a "new word" is corrected in the historical sketch of the article.

Ibid., pp. 40–42.

THE principal object of this paper was to point out the wide schism which exists at the present epoch between the theories of political economists and the practices of States. The former are dominated by the negative ideas of Adam Smith and the English doctrinaires, which constitute nearly all the literature of the subject, and are taught and professed almost universally. Notwithstanding this it was shown by profuse illustrations from history and statistics that the policy pursued by the various governments of the world is totally opposed to these teachings, and scarcely at all affected by them. The political economists declare that the true province of government is simply to protect the spontaneous operation of natural laws working in society, which will then work out all the results of civilization, and that any interference with these natural operations will be either wholly inoperative or will result in mischief. They found their doctrines upon the observed phenomena of the physical world which are known to be uniform and invariable. This they hold to constitute true political science, analogous to all physical science.

Notwithstanding the unanimity of writers, past and present, on this subject, positive state regulation, especially during the last quarter of a century, has made rapid strides, and nearly all civilized governments are openly violating these economic rules. The post office, the telegraphs, and the railways of many countries are passing under government control, while national banking and national education are rapidly superseding private banking and private instruction.

It was further shown that the desire for positive regulation consists for the most part of a mere intuition, or social instinct, and coexists, even in the same individual, to a great extent with the incompatible belief in the *laissez faire* policy of the schools. This greatly complicates the problem, and renders it highly important that a clear exposition of the grounds on which the positive policy is conducted be made. In seeking to do this it was shown that the unrestrained operations of natural laws in social phenomena invariably result:—

41 1. In unjustifiable inequalities in the distribution of wealth, due to the general truth that there is no necessary harmony between natural law and human advantage.

2. In enormous waste of created products, due to the ruinous excesses of competition, entailing failures and losses.

3. In artificially increased prices, due to over-supply, the result also of competition, especially in distributive industries.

4. In dangerous monopolies, whether industrial or financial, which threaten to enslave labor and dictate commerce.

These propositions were supported by statistics of corporations and of public and local debts. It was also argued that, from the standpoint of science and the laws of evolution, all these results are the normal and legitimate products of natural law, and that there is no tendency in unregulated nature to reverse the process and disentangle these complicated social phenomena.

It was moreover denied that all attempts at government regulation had proved failures or resulted in an excess of evil to society. The various industries which have been absorbed by government and successfully conducted were enumerated at length, and it was shown that there were many such in this country, still more in Great Britain, and a maximum number on the continent of Europe. The extent of State ownership and management of telegraph lines in England and in Europe generally, and of railroads in Germany, France, Belgium, and Italy was exhibited by facts and figures; the prevalence of national savings banks throughout Europe and the character of the systems of education of Germany, Austria, France, and England were adduced in support of this view, as also the tendency now manifest towards the protection of home industries throughout the world.

From this basis of facts and from history the broader
generalization was then made, that all the now recognized
government functions have once been under a system of
private management, and have had, each in its turn, to
pass through the stage of opposition from those who would
keep them so, and one by one have gradu|ally taken
their places as integral parts of the system of govern- 42
ment. Finance and jurisprudence were given as examples of
this truth, the former of which has scarcely as yet and the
latter only quite recently assumed its true position. This
process is moreover destined to continue, until all truly

public operations shall come more or less directly under the power of state regulation. Contrary to the general belief, this result is not often reached before the time is ripe for it. Such is the aversion to innovation that the evils of private management usually become well nigh intolerable before the state is able or willing to step in and relieve them.

The want of an adequate term for expressing this conception of the assumption by the state of the control of interests of a public nature was next pointed out, and it was proposed to designate the entire movement by the name *Sociocracy*, as a new word, etymologically akin to *sociology*, and avoiding the stigma which attaches to all expressions for the government regulation of industries whose public nature is disputed. This term embraces all the functions of government, whether universally acquiesced in or not. It also conveys a distinctly different meaning from either *democracy* or *socialism*, and stands simply for positive social action as opposed to the negative or *laissez faire* policy of the predominant school of politico-economic doctrinaires. It recognizes all forms of government as legitimate, and, ignoring form, goes to the substance and denotes that, in whatever manner organized, it is the duty of society to act consciously and intelligently, as becomes an enlightened age, in the direction of guarding its own interests and working out its own destiny.

November 15, 1882—Ætat. 41.

128. [Virtual vs. Nominal Chiefs]

History.—Remark on the paper of Prof. Otis T. Mason on "The Savage Mind in the Presence of Civilization," read April 5, 1881.

Ibid., p. 47.

MR. WARD inquired whether there was any evidence of nominal subordination of the virtual to the regular chief, analogous to that which exists in many countries where the Prime Minister is the virtual ruler, and the hereditary king or queen a mere figure-head.

Major Powell replied that such evidence existed, and gave an illustration in support of that view.

November 15, 1882—Ætat. 41.

129. [Vowel Systemization]

History.—Remarks on the paper of Prof. Samuel Porter on "Vowel Systemization," read June 7, 1881. The previous paper referred to is that on "Savage and Civilized Orthoëpy" (see No. 112, Vol. II).

Ibid., p. 61.

MR. WARD called attention to the similarity of the conclusions reached by Prof. Porter to those which he had announced in a paper read before the Society on the 21st of December last, and read a paragraph from the abstract of that paper as printed in the "Abstract of Transactions," (p. 106). He also testified to the general rationality and correctness of the order in which Prof. Porter had arranged the principal vowels with respect to the probable location of the sound in the mouth and pharynx. He commented upon Bell's chart representing his system of vowel sounds, and pointed out a number of inconsistencies in it.

November 15, 1882—Ætat. 41.

130. [Symbolic Interpretation]

131. [Origin of the Arabic Numerals]

History.—Remarks on the paper of Col. Garrick Mallery on the "Dangers of Symbolic Interpretation," read on Oct. 18, 1881.

Ibid., p. 79.

MR. WARD raised the question whether the letter, read by Col. Mallery, on the symbolic interpretation of this chart, might not have been intended as a burlesque.

Col. Mallery stated that it bore every mark of sincerity and genuineness.

Mr. Ward inquired whether the recent attempts to explain the origin of the Arabic numerals as a modification of straight lines rested on any authentic basis.

Col. Mallery thought it did not.

November 15, 1882—Ætat. 41.

132. [Intellectual Work of Deaf Mutes]

133. [Language a Product of Intelligence]

History.—Remarks on the paper of Dr. Edward M. Gallaudet entitled: "How Shall the Deaf be Educated?", read Nov. 1, 1881.

Ibid., pp. 83–84.

MR. WARD asked if any data existed for determining whether educated deaf-mutes, as a class, had contributed their share to the intellectual work of the world, and mentioned the case of Mr. Leo Lesquereux, the well-known vegetable paleontologist. He said that, considering how small the class is, it would not, of course, require a very great absolute number to constitute its quota.

President Gallaudet thought that it had done so, and instanced a number of deaf persons, of greater or less distinction in one way or another, among them John Kitto, Charlotte Elizabeth, Ferd. Berthier, and two brothers Moore, of Hoboken, embracing various professions, authorship, and art. He further remarked that, of the graduates from the National Deaf-Mute College, one had become a successful patent lawyer and another an editor.

Mr. Henry Baker spoke of Mr. Parkinson, the patent lawyer referred to, testified to his intelligence and business ability, and said that the degree of master of arts had been conferred upon him.

Mr. Ward said he thought the facts showed that the art of communicating ideas was a necessary result of the possession of ideas | to communicate, and depended 84
less than was commonly supposed upon the possession of the faculty of oral speech. He expressed his belief that if the human race, all other things being as they are, had been destitute of that faculty they would have nevertheless found means of carrying on the various functions of civilized society very nearly the same as they now do.

November 13, 1882—Ætat. 41.

134. [Geographical Distribution of Human Races and Animals]

History.—Remarks on the paper of M. W. B. Hough entitled: "A Question in Classification," read Dec. 6, 1881.

Ibid., p. 92.

UPON this communication Mr. Ward remarked that he had been struck by the analogy which it suggested between the geographical distribution of the human races and that of the lower animals and of ts. It seemed that in the one case as well as in the r the physically inferior types predominated in the hern hemisphere, and particularly in South America and Australia. Africa, however, constituted an exception, so far as animals and plants were concerned, and he raised the question whether this might not be due to the fact that geologically that continent properly belongs with Europe and Asia, with which it was connected until quite recent times, and whether the size of land areas did not have something to do with the degree of development made by the life inhabiting them; he also queried further whether this might not be in turn due to the relative length of time during which such development has been going on, presuming that it might have begun much earlier on the great northeastern continent. He spoke of the oft-repeated remark made by geologists and naturalists that America is really the Old World, and said that, in so far as life at least was concerned, the reverse must be the case, if, by the age of a fauna is meant the length of time it has been developing, as measured by the degree of advancement attained. From that point of view Australia would be the youngest continent, after which would follow South America, then North America, making the Old World in fact old zoologically and phytologically as well as anthropologically. That the human races, notwithstanding their superior migratory-power, had retained certain of the same geographical peculiarities that characterize the lower forms of life, he thought quite probable.

135. The Anthropocentric Theory*

History.—This abstract of the paper read December 20, 1881, was written out in its present form December 24–27, 1881. The paper in full was never published as such, being read from proof-sheets of *Dynamic Sociology*, Vol. II, Chapter VIII, where it occurs on pages 44–73.

Ibid., pp. 93–103.

THE aim of the paper was to bring together into something like logical order a few of the more salient facts which have been cited in favor of and against the belief in the existence of a beneficent agency in nature, more especially as operating in the direction of the welfare and advantage of man, considered as the end toward which the various processes of the universe have tended. These statements of fact were accompanied by such explanations, qualifications, and other comments as seemed necessary to secure their proper appreciation and their true bearing upon the problem.

The speaker called attention to the fact that writers of a teleological bias are continually advancing what they regard as proofs of intelligent design and benevolent provision in behalf of sentient beings, especially man. Until within

*This paper will form part of Chapter VIII of the author's work *Dynamic Sociology*, Vol. II, pp. 44–73.

quite a recent period all philosophy was strictly *anthropocentric*, and the lower grades of creatures capable of enjoyment and suffering were wholly ignored; but in later times a few of this school have expanded their scheme to embrace the animal world in general, rendering it *zoöcentric* instead of anthropocentric, although the existence of large orders of purely predatory creatures had proved a somewhat discouraging fact for their philosophy to assimilate.

Most of the examples that have been brought forward as establishing the operation of a designing intelligence and beneficent | intent in the universe—optimistic facts,
94 so called—can be classed under two general heads: They are either, 1, cases of natural or genetic adaptation; or, 2, they are mere coincidences.

Still a third class was, however, named in which the advantage is more apparent than real and becomes greatly reduced or disappears altogether on closer examination.

Under the first of these groups the following instances were enumerated:

1. A modern scientific writer had stated that in the case of the maternal instinct it was a mere accident that the course of action which the instinct prompts should be one that was conducive to the welfare of the offspring.

Against this view it was urged that this apparently fortuitous adaptation was clearly a genetic one and had been developed under the operation of the selective laws now generally recognized in biology.

2. The alleged excess of male over female births, supposed to be brought about for the purpose of supplying the loss of males incident to war and their more exposed mode of life, was questioned as a fact; the loss of males by violence being, probably, nearly compensated for by the greater delicacy of maternal functions; yet, if the supposed excess were proved, it might do no more than show that it was an advantage that it be so, which, on adaptation principles, would amount to accounting for the fact.

3. That the specific gravity of aquatic animals should

almost exactly equal that of their medium was held to be a clear case of natural adaptation.

4. The allied fact that the bones of birds are hollow and communicate with the outer air was explained in the same manner.

5. The existence of the coal measures was cited as a favorite theme of optimists, and it was shown that it partook of the character partly of the first and partly of the second group. If it be true, as generally believed, that the process of their deposition had the effect to purify the atmosphere of its alleged excess of carbonic acid gas, then the fact must have constituted one of the conditions | to
the development of higher forms of life, including hu- 95
man life, and as such it performs the office of an *efficient* and not a *final* cause. Since the close of the sixteenth century, when coal began to come into general use as fuel, it may have also produced a new effect upon the development of the race by greatly enhancing their comfort and consequent efficiency for action. In so far the correlation between the existence of the coal measures and the advancement of man has a causal relation and constitutes a case of adaptation; in any other sense it must be regarded as a pure coincidence.

6. Very similar to this case is that of the late appearance, geologically speaking, of the most important economic families of plants, and particularly the *Rosaceæ* and *Gramineæ*. These plants were shown to have been, equally with the coal measures, a condition to the existence of the higher forms of animal life which have been genetically adapted to them. Considered from any other point of view the coexistence is purely accidental.

Under the second group, or that of pure coincidences, the following cases were noted:

1. The alleged advantage to man of the spheroidal form of the earth in preventing irregularities in its motions, due to mountains and other inequalities of its surface, which the

equatorial *meniscus* neutralizes. This, Kant, who first suggested it, proposed to explain on teleological principles, and he rebukes the attempt to explain it as due to the equilibrium necessarily produced by the formerly fluid mass of the rotating planet. But as the mechanical explanation is complete without the teleological one, and will apply to any case, even where it might be a disadvantage, the latter is at least unnecessary.

2. The fact that there is no relation of dependence between the dispersive and refractive powers of different substances, and which alone renders the construction of the achromatic lens possible. This was mentioned as a most fortunate case under the present head; but it was questioned
96 whether this were not rather to have been | expected
than the contrary, and whether admiration be really the proper attitude to maintain towards it.

3. It had been remarked by Brinkley "that if the velocity of light had been much less than it is astronomy would have been all but an impossible science." If it had been greater than it is, however, astronomical observation would have been in the same degree facilitated; and there was the same antecedent probability that it would be greater as less.

4. As a final case under this head was noted the circumstance that if the manufacture of alcohol had been so simple a process that the lowest races could have at all times obtained an unlimited amount of it, this would probably have effectually prevented the social development of the race, if it did not entirely extinguish it. It is a fortunate coincidence, therefore, that its production is only possible by races that have advanced far enough intellectually to be capable of foreseeing to some extent its evil effects and of exercising a certain control over their appetite for it.

Passing to the third group, or those instances in which the advantage is more apparent than real, only a single case was adduced as a type of the class.

This was the fact, so strenuously insisted upon by certain

physicists, and notably Count Rumford, as a wise provision of nature in the interest of man, that water attains its greatest density at about $39\frac{1}{2}^\circ$ Fahrenheit, instead of at the actual freezing point. This view was based upon the supposition that if it were otherwise all bodies of water, even the ocean, would be frozen solid as often as the temperature fell to 32°. The fallacy of this reasoning has long been exposed, and it has been shown: first, that this property does not apply to the salt water of the ocean, which is about in the state from which the worst results of the theory would occur; second, that these results do not occur there, and would not in any liquid, but rather the opposite ones, viz., that bodies of water would never freeze over in temperate climates at all, since the superincumbent mass
of the water would prevent the cold from penetrating 97
to the bottom, where alone congelation could take place if ice were heavier instead of lighter than water; and, third, that instead of water having been singled out as the only substance to be endowed with this property, it is now found that many others possess it, such as glass, bismuth, antimony, and even iron; so that independently of design the chances that water should possess it are about the same as that it should not, while the property itself is really of very doubtful advantage.

Upon an enumeration, therefore, of such cases only as seem to favor the anthropocentric theory it was maintained that the claim was a weak one. Unless the theory of adaptation is wholly rejected, the greater part of the illustrations fall under that head. A large share of the remainder are such as would be as likely to occur in the manner that they do, as otherwise, under the operation of the mathematical law of probabilities. The number of coincidences that can be noted is not greater than ought to be expected, or than are met with in other departments of human experience, while a few cases turn out, when fully understood, to be of doubtful advantage.

The speaker next proceeded to enumerate cases of the opposite general class, or such as seemed opposed to the doctrine of a special beneficent agency in the interest of man. This, he stated, was a much easier task than the preceding, which is itself a strong presumption against the optimistic view.

The illustrations adduced were grouped under three general heads, viz., 1, such as exhibit a condition generally unfavorable to life on the globe, either of men, animals, or plants—*anti-biocentric facts;*—2, such as negative, in one form or another, the assumption that the human race has been the special object of benevolent design—*anti-anthropocentric facts;*—and, 3, those in consequence of which social progress tends to defeat itself—*anti-sociocentric facts.*

98 | A bare enumeration of the many cases cited is all that can be given in this abstract.

Under the first of those groups the following facts were set down:

1. That the longitudinal cohesion of the outer bark of many trees restricts their natural growth by binding the trunk too tightly and compressing the cells of the cambium layer. So obvious is this that horticulturists successfully relieve them by artificially slitting the bark.

2. That many plants bloom during a period of mild weather in autumn or winter, when there is no possibility that their fruit can reach maturity.

3. That the sting of many insects is so strongly barbed that it cannot be withdrawn from the body stung, but instead is extracted from that of the insect along with the viscera to which it is attached, resulting in the death of the latter. As only females are provided with stings the destruction of so many of that sex must be a disadvantage to the species.

4. That female opossums having only thirteen teats have been known to give birth to fifteen or sixteen young, and, as the continued life of each embryo depends upon its

permanent attachment to a teat, the excess over the number of the latter must necessarily perish.

5. That moths, beetles, ephemeræ, and other insects possess a suicidal propensity to fly into a flame.

6. That birds and animals on newly discovered islands have no innate fear of man, and allow themselves to be readily caught, so that they are soon exterminated.

7. That animals attacked with rabies immediately acquire a disposition to bite others, whereby the deadly malady is multiplied.

8. That many imperfectly integrated annelids labor under a great disadvantage from being obliged to support a multitude of similar organs in different somites.

While none of the above facts are capable of a teleological, or optimistic explanation, it was shown in each case that from the point of view of evolution they may all be readily accounted for.

| Under the second, or anthropocentric group proper, 99
the following facts were co-ordinated:

Three cases, under the general head of "rudimentary organs," as they are called, which, while they perform no known functions, are at the same time the seats of dangerous diseases, viz.:

1. The tonsils, as the seat of tonsilitis.

2. The thyroid gland, the seat of the disease called goître, or bronchocele.

3. The vermiform appendage of the intestines, in which two dangerous forms of disease are located.

Each of these has been traced back to a form in the lower animals, in which it was an active organ, which not only accounts for the existing vestige on true scientific grounds, but at the same time argues the descent of man from them. Yet this fails to relieve the optimist from the onus of proving a teleological advantage from them as they now exist.

4. Allied to these cases, but of less general renown, is that of the exposed condition of the lower extremity of the spinal cord, which, under certain circumstances, becomes the

seat of a fatal malady known as rachidian meningitis. This condition, which is peculiar to man, is explained morphologically as a result of the assumption by man of the erect posture, in separating the sacral vertebræ and exposing the spinal cord.

The remaining cases cited under this head were taken from widely different fields:

5. That the ability to predict the weather is at once the most practically important and the most limited of scientific achievements.

6. That, as Laplace has shown, the elements of the solar system, from the human point of view, fall far short of the optimum.

7. That if, as many astronomers suppose, the moons of the larger planets are inhabited and derive their light and heat chiefly from their primaries, it is an ill-devised arrangement that in all cases they should always present one and the same side to them, leaving the other hemisphere in perpetual darkness.

100 | 8. That it would be much better for man if there could be about sixteen hours day to eight of night, corresponding to the normal requirements of activity and rest, and saving an average of four waking hours in darkness, with the accompanying cost of artificial illumination.

9. The misfortune was dwelt upon that all races should have been condemned to the use of either the quinary, decimal, or vigesimal system of notation, when either nine, twelve, or sixteen, but especially eight, would have constituted a basis so much superior in point of practical value. Genetically, it is easily explained as the result of man's possession of twenty digits.

10. That the human body should possess a specific gravity a trifle greater than that of water, coupled with the fact that man is not endowed with a natural instinct to swim; and this on a planet of whose superficial area two and four-fifths times as much is water as land, and which he is obliged to traverse in all directions. His supposed descent

from purely terrestrial, or even partially arboreal anthropoid apes, would be a satisfactory genetic explanation of both these circumstances; but its admission would be no relief to the optimist from explaining them teleologically.

11. The brevity of human life was cited as an important barrier to intellectual progress. So large a portion of every one's lifetime is required to prepare for any useful work that little time is left for its accomplishment, and many are deterred from undertaking anything of real value. This, it was maintained, might as well have been otherwise, as there is nothing necessarily impossible in the limit of human life being two hundred years any more than in its being one hundred.

12. Living beings are so constituted that they multiply many times, often many hundred times, faster than their conditions would permit if the excess were not constantly kept down by the friction of the environment manifesting itself in a variety of ways. In the case of men, who form no exception to this law, disease, accident, violence, war, pestilence, and famine are among the | scourges that 101
perform this office, the true cosmical nature of which is masked by our familiarity with the phenomena. The amount of suffering that would be saved if, instead of this method, that of diminished fertility or the destruction of unborn germs of life were adopted, is incalculable.

To these cases were added the following wholly disconnected but none the less apposite facts:

13. That the worst of all living enemies of mankind are too minute to be discovered by the highest-powered microscopes—the germs of disease.

14. That in temperate latitudes, where the bulk of the world's population occurs, northerly winds predominate in winter and southerly in summer, thus exaggerating the extremes of heat and cold.

15. That in mountainous regions the rainfall is chiefly on the tops of the mountains where it is not needed, leaving the otherwise fertile valleys and plains arid and parched.

16. That the most useful as well as the most beautiful objects in nature are usually the most rare.

17. That, whereas pleasures are usually moderate and brief, pains are often intense and protracted.

Under the last of the three general classes of anti-optimistic facts specified above, viz., the anti-sociocentric, or anti-progressive group, it was shown:

1. That social progress is rhythmical, and that its alternate flows and ebbs occasion incalculable waste, from the circumstance that only a part of what is gained by the flood-tide is retained after the ebb-tide is over.

2. That the study of phenomena has always had to be commenced from the top, and that the superficial view must be taken before the fundamental view can be gained; so that the work of intellectual progress has consisted in the removal, not merely of ignorance, but of error.

3. That moral and social science, the most practically
102 important | branches of knowledge, labor under difficulties from which all other sciences are exempt, since every attempt to analyze the phenomena of human action and social life into their simpler elements—a process essential to the study of any science—conflicts with received opinions and shocks a morbid sense which claims a preternatural character for the human race.

4. That the labor performed in the interest of social progress is unremunerative, and must usually be performed in the face of strenuous opposition; which is alone sufficient to deter most men, however capable, from undertaking it.

5. That true merit is generally content to remain in obscurity, while the volatile elements of society thrust themselves into undue prominence and exert a greatly disproportionate influence.

6. That the mass of mankind wholly misconceive their own interests, and are generally found siding with the party that seeks to despoil them of their most valuable rights and liberties.

7. That the past tendency of the human intellect has

been to ignore realities and waste its energies on empty speculations about transcendental questions.

8. That, while men have always had the most need, they have, at the same time, manifested the least disposition to exercise their intellectual faculties.

9. That in the present state of scientific progress the discovery of truth is rapidly distancing popular intelligence, so that it is impossible to assimilate the knowledge brought forth.

And finally:

10. That each and all of the many errors which the increasing intelligence of the world has successively swept away, have been defended to the last by at least a few of the most honored minds of the age, and have at last been compelled tardily to succumb to a sort of popular verdict, or to the combined force of the lesser lights and younger heads, reluctantly declining to follow longer those to whom they had been accustomed to look for counsel and intellectual guidance.

| In conclusion the speaker remarked that there were
some to whom an apology might be due for so pro- 103
tracted an enumeration of the pro's and con's of optimism—a philosophy which may be supposed to have long been obsolete. To such, however, he could only express his regret that the mass of mankind have by no means reached their advanced position. While optimism, as a philosophic tenet, defined by the scholars of a century ago, has, it must be admitted, ceased to engross the attention of thinking minds, the qualified form of it which constitutes the anthropocentric theory, and toward which the foregoing considerations have been principally directed, still forms the very warp of the current philosophy outside of the domain of science, and to a great extent within that domain. It is the essence of all teleological conceptions, and so generally pervades the prevalent views of life and action, as to distort completely the popular conception of the relations between man and the universe. The great mass of men still believe

in a conscious intelligence, either without or within the universe, which is perpetually adjusting means to ends in nature. The majority regard that intelligence as in a manner benign and sympathetic, and while shutting their eyes to such facts as have been here set forth, are ever on the alert to gather evidence, however slender, in support of providential interference and intelligent design.

136. The Organic Compounds in Their Relations to Life.[1]

History.—Written Oct. 10–17, 1881. This paper is a sequel to the one on the "Evolution of the Chemical Elements" (see No. 109, Vol. II). It traces the process of chemical organization up to the point where, without any essential change in its character, it becomes biotic organization, this point being the one where molecular activities become molar. I consider it one of the most original, as well as one of the most important, of all my contributions to scientific philosophy. In my *Pure Sociology* (pp. 117–118) I refer to it, and in the footnote on p. 118, to statements by others of practically the same truth, but so much later that they may be safely assumed to have derived their ideas from this paper. I desire here to draw attention to a still more complete restatement of nearly all the views expressed by me in this paper, and some of those contained in the one to which

[1] Read before the Philosophical Society of Washington, January 28, 1882; also read before the Biological Section of the American Association for the Advancement of Science at Montreal, August 29, 1882.

it is a sequel. This was in an article by Prof. Joseph LeConte entitled: "The Theory of Evolution and Social Progress," which appeared in the *Monist* for July, 1895 (Vol. V, No. 4, pp. 481–500). The part entitled: "Kinds or Grades of Evolution," and occurring on pages 488 to 489, is almost in my language. I had known Professor LeConte several years before my own paper appeared, and we had regularly exchanged publications. I always kept a record, which I still possess, of all to whom I ever sent my reprints. A reference to it shows that I sent him this paper when it appeared. Of course in the seven years that had elapsed he may have forgotten whence he derived his ideas, and I have no intention to charge him with plagiarism. Rather would I use it as an example of the momentum of ideas when once started in their path, so that one never knows what remote effects a new idea may produce, especially if it is published somewhere. This truth yields a strong consolation to those who are apt to feel that the ocean of thought is so immense that the few crumbs cast into it are forever lost.

The American Naturalist, Philadelphia, Vol. XVI, No. 12, December, 1882, pp. 968–979.

IN a paper on the "Formation of the Chemical Elements,"* read March 29, 1879, before the Philosophical Society of Washington, I proposed the following *cosmical definitions* of the three principal known forms of matter:

* "Evolution of the Chemical Elements," in the *Popular Science Monthly*, Vol. XVIII (February, 1881), pp. 526–539.

"*1. Chemical Elements.*—Substances whose molecules are composed either of those of other chemical elements of less atomic weight, or of such as are too low to be capable of molar aggregation, and therefore imperceptible to sense: formed during the progress of development of star-systems at temperatures higher | than can be artificially produced, and hence too stable to be artificially 969 dissociated.

"*2. Inorganic Compounds.*—Substances whose molecules are composed of those of chemical elements or of other inorganic compounds of lower degrees of aggregation: formed in the later stages of the development of planets at high but artificially producible temperatures, and therefore capable of artificial decomposition; and constituting the greater part of the solid crust of cooled-off bodies, their liquid, and a portion of their gaseous envelope.

"*3. Organic Compounds.*—Substances whose highly complex and very unstable molecules are composed of those of chemical elements, inorganic compounds, or organic compounds of lower organization: formed on the cooled surfaces of fully developed planets at life-supporting temperatures."

In that paper I endeavored to show that the so-called chemical elements differ from one another in ways which strongly suggest the possibility that some of them may have been evolved from simpler constituents in much the same manner as the inorganic compounds are formed. These latter were therefore treated as simply forming the continuation of a uniform process of evolution, varied in its character only by the conditions of temperature affecting the globe at the period when these substances were respectively formed upon it. The passage above quoted from the same paper shows also that the development of the organic compounds was looked upon as the still further prolongation of this uniform law operating under the greatly lowered temperatures prevailing on the surface of the earth's crust after its formation. This law was further shown to be none other than that which is known to prevail in each of the higher domains of phenomena, in the mineral, the vegetable, and the animal world—the production of aggregates of higher orders of complexity through the recompounding of units of lower degrees of simplicity. As indices of this law, and facts of primary significance, it was shown that throughout the scale, so far as traceable, even in the domain of the chemical elements, the molecules constituting each progressively more complex unit, exhibit *increase of mass* accompanied by *decrease of stability*.

The present paper will aim to take the subject up where the former left it, and to confine itself exclusively to an
970 examination | of the last and highest of these products of Nature's alembic—the Organic Compounds.

These substances, as they exist on the globe, are for the most part products of organization, and they were long supposed to possess such subtile properties and composition as to be ever necessarily inscrutable to man. But quantitative chemistry has, within the last half century, not only succeeded in the complete analysis of all such substances obtained from organized beings, but it has also effected the synthesis, or reproduction out of their inorganic elements, of thousands of them. Thus Wöhler, Berthelot, Kolbe, Friedel, Piria, Wertheim, and others have accomplished the manufacture of such bodies as urea, formic, oxalic, lactic, and salicylic acid, numerous alcohols and ethers, glycerine, and a host of essences, including wintergreen, vanilla, mustard, cinnamon, camphor, etc., as well as alizarine and indigo dyes. These facts are sufficient to obliterate completely the line of demarkation formerly supposed to exist between the chemical constitution of inorganic and organic compounds, and when it is remembered that the latter differ as widely from one another as they do from the former in complexity, the uniform process of molecular aggregation cannot be regarded as interrupted at this stage. There is also much indirect evidence, though amounting to proof in but few cases, that the organic compounds, at least some of them, are sometimes directly formed by nature out of their inorganic constituents without the intervention of organized bodies.

These substances have their peculiar properties depending, like those of all other substances, on their molecular constitution; the artificial glycerine possesses the same sweet taste as the natural product, the manufactured spices yield the same aromas, and the laboratory dyes the same colors as those of the Orient. Many organic compounds are exceedingly complex, their molecules being relatively large, containing several thousand times as much matter as a molecule of hydrogen. Their instability, moreover, bears some proportion to their complexity. Most of them are colloidal in structure and refuse to crystallize; a few of the simpler ones, however, in which the proportion of oxygen is large, as sugar, for example, become crystalline under certain conditions.

The only element which is never absent from any of these compounds is carbon. Oxygen is almost universally present, and the | hydrocarbon group from which it is wanting 971
is quite distinct from all others. Hydrogen comes next in point of regularity, and these three elements make up the great bulk of all organic matter. When nitrogen is added a marked change is made in the nature of the compounds. The nitrogenous group is distinguished especially by its great instability, and also by the number of isomeric forms which these bodies are capable of assuming. The only other elements that enter to any great extent into organic compounds are sulphur and phosphorus. These occur in limited but definite proportions in many of the most complex substances.

The remarkable contrasts which the elements of organic compounds present when compared with one another have been frequently pointed out by different writers, and they are certainly adequate to explain most of the properties possessed by these bodies. The chief characteristic of oxygen is its great chemical activity, or tendency to combine with other substances, while that of nitrogen is its inertia, or inability so to combine. Carbon is a solid at all temperatures producible on the globe, while all the other three chief constituents of organic matter are practically incapable of solidification. This fact is a measure of the degree of cohesion of the homogeneous molecules composing the respective molar aggregates; that of carbon is intense, while that of hydrogen is exceedingly slight. While this in each case depends on the degree of heat, it will be relatively the same among them all at any given temperature.

It would appear that all the attempts, so to speak, on the part of nature to form compounds of the gaseous elements alone have resulted, where successful, in substances which are at once pronounced inorganic, such as water, H_2O, ammonia NH_3, nitric acid, HNO_3, etc. It is remarkable that while the chief compound of the two persistent gases, hydrogen and oxygen, is liquid (water) or solid (ice) at our temperatures, that formed of the persistent solid, carbon, in combination with one of these gases, oxygen (carbonic dioxide, CO_2), is a gas at all ordinary temperatures and pressures. Notwithstanding this, it can not be doubted that carbon is the agent which, by its great molecular cohesion prevents the dissolution of the higher compounds and renders organic substances possible.

As already remarked, the transition from the inorganic to the organic is, from the point of view of chemical structure, purely | nominal, and the existence of any hard and
972 fast line marking off one of these fields from the other has long been denied. If there were any advantage to be derived from such a line perhaps it could not be drawn in a better place than that where carbon unites with hydrogen or nitrogen, either with or without oxygen. This, it is true, would place all the hydrocarbons, as well as cyanogen, in the organic series. On this view, therefore, the inorganic compound most nearly related to the organic series would be carbonic acid, or, as it is now more properly called, carbonic dioxide, CO_2, of whose inorganic origin there can be

no doubt. The simplest organic compounds consist chiefly in the addition of different proportions of hydrogen to this basis and the reduction of the proportion of oxygen. In the various hydrides (methylic, CH_4, ethylic, C_2H_6, amylic, C_5H_{12}, etc.), the oxygen disappears altogether. In the alcohols it reappears only in the addition of one oxygen molecule, to the respective hydrides. The acids result from an additional increase in the proportion of oxygen (formic, CH_2O_2, acetic, $C_2H_4O_2$, etc.). The actual development of the organic compounds, as it may be supposed to take place in nature, would seem to be in the reverse order to that above given, the organic acids being first formed from inorganic compounds by the addition of hydrogen, then the alcohols from these by still further increase of hydrogen accompanied by a reduction of oxygen, and lastly, the hydrides from the alcohols by the loss of the one equivalent of oxygen remaining in the latter. The different kinds of acids, alcohols, and hydrides, arise from varying the proportions of hydrogen and carbon. The simplest change possible may be indicated thus:

$$\overbrace{CO_2}^{\text{Carbonic dioxide.}} + H_2 = \overbrace{CH_2O_2}^{\text{Formic acid.}};$$

$$CH_2O_2 + H_2 - O = \overbrace{CH_4O}^{\text{Methylic alcohol.}};$$

$$CH_4O - O = \overbrace{CH_4}^{\text{Methyl.}}, \text{ etc.}$$

When we look at the higher and more complex compounds, we can readily see that they may be composed of the lower ones as their molecular constituents. This is, to a great extent, assumed by chemists, and the chemical synthesis of a large num | ber of these substances has been carefully worked out. In the formation of sugar ($C_{12}H_{22}O_{11}$), 973 starch ($C_{12}H_{20}O_{10}$), gum ($C_{12}H_{20}O_{13}$), etc., the proportion of oxygen is quite large, and the phenomena of crystallization may occur under certain circumstances.

The oils are a still more complex group, being formed by the union of very feeble acids with the common base, glycerine ($C_3H_8O_3$). They are colloidal under all conditions, and decompose much more easily than the amyloids.

The most important organic compounds, however, especially from the biological point of view, are those containing nitrogen. These fall under two general classes, and constitute the so-called organic bases on the one hand, and the albuminoids on the other. The former of these groups have been for the most part extracted from vegetables of which they constitute the "active principles," or characteristic properties, although, as we saw, a large number of them have been artificially manufactured. As illustrations of the nature and composition of these substances may be mentioned, morphine ($C_{17}H_{19}NO_3$), narcotine ($C_{22}H_{23}NO_7$), quinine ($C_{20}H_{24}N_2O_2$), strychnine ($C_{21}H_{22}N_2O_2$), etc. It will be seen that the principal particulars in which these fundamentally differ from the organic compounds already considered, consist in the addition of a small percentage of nitrogen and the reduction of the proportion of oxygen; yet the properties which they possess are a hundred-fold more active.

The composition of the organic bases, however, though somewhat complex, is simple compared with that of the albuminous compounds. These contain, in addition to the elements of the former, small, but rather definite proportions of both sulphur and phosphorus. The number of molecules of each of the components indicates a large, complex molecule as the unit of composition. The expression for albumen as given by Liebig was: $C_{216}H_{338}N_{54}S_3 O_{68}$. Could this be relied upon this substance would contain 679 equivalents of different weights, which, when reduced to the standard of hydrogen, would indicate a molecule for albumen 4870 times as large as the hydrogen unit. The molecule of fibrin is supposed to be still larger than that of albumen.

The substances thus composed, as we should naturally expect, are very unstable and possess remarkable properties. They constitute the substance of the muscles and nerves of the animal sys | tem and the fibrin of blood. They are also found in all cells whether animal or vegeta- 974
ble. The base of the entire group is known as *proteine*, so named from its remarkable power of assuming different isomeric forms, of which it presents some thousand or more. Proteine contains no sulphur nor phosphorus, and its formula as given by its illustrious discoverer, Mulder, is, $C_{18}H_{27}N_4O_6$. Each of its units would thus be composed of 65 elementary molecules, the combined mass of which would be equal to 395 molecules of hydrogen. All the actual known substances of this group have, therefore, more complex molecules than those of this still, to a great extent, theoretical one.

While the albuminoids possess none of the active properties of the organic bases, they far exceed them in the power they have to change their form, and adapt themselves to the needs of organized beings. All properties in material bodies are the result of reactions taking place in their molecular constitution when brought into contact with other bodies. They are recognized only when they directly or indirectly affect the senses. As a rule, the larger their molecules, the more powerful their effects. In the case of the albuminoids, with their comparatively enormous units of aggregation, the entire substance is transformed with only slight external influence, either of heat or chemical contact, and either assumes new characters or breaks up into the simpler organic compounds of which it is composed.

The general law above stated, that in the progress of the evolution of matter from the simplest elemental state to the most complex organic compound, there has constantly been increase in the mass and decrease in the stability of the molecules, holds good throughout, and to it may now be added a third principle, obviously correlated with the above, and merely constituting a corollary to it, that *pari passu* with these changes there has been an *increase in the activity of the properties* manifested by the substances evolved.

Although varying through wide degrees in this respect, all the substances thus far mentioned possess sufficient stability to be retained, handled, and examined, and to the ordinary observer they present very much the same general appearance. While possessing many special qualities distinguishing them from other bodies, the albuminoids, as well as all the other organic compounds, appear to be and are incapable of any visible automatic movement. |
975 We are obliged, however, to suppose that these, like other solids even the densest crystals or metals, possess at all times molecular activities. It is these activities that determine the respective properties of all substances, and constitute the multiple and varied in nature. In proteine bodies, these molecular activities are much more extensive and varied than are those of simpler bodies. The molecular units are so much larger that their motions must be, as it were, *molar* in comparison, while within these larger primary units there are lesser units of different orders of aggregation, each of which manifests its own appropriate activities, and thus modifies the general properties of the whole. The reason why we are unable to see these motions, is simply because they are still on far too small a scale to be directly observed either by the eye or by any of the appliances yet devised for intensifying human vision.

The development of the albuminoids, highly complex as they are, is not alone sufficient for the immediate genesis of life. A form of matter still more complex, must be reached before this result is possible. But there is no evidence that this form of matter is produced by any different process from that by which other forms of matter are produced. From the molecule of hydrogen to that of albumen, the process of evolution has been uniformly the same, viz., that of compounding and recompounding, of double and multiple compounding; in short, it has been the process of molecular aggregation. It would be contrary to the law of uniformity in natural phenomena, upon the recognition of which modern science is based, to assume an abrupt change in the process at this point, and upon those who maintain such a *saltus* must rest the burden of proof.

Dealing, as we constantly must do, with molecules only, we are able to form conclusions only from observed effects, but we have seen that, without changing the elementary substances which analysis can demonstrate to be present at any stage of the process, with each new step in the progress of aggregation new and higher properties are created. From the inert properties of carbon and nitrogen in the free state, of water and carbonic acid, the simplest compounds, we have, by further successive compounding, the more active ones of ammonia and nitric acid, the sweet taste of sugar and glycerine, the powerful narcotic principles of nicotine and morphine, the deadly toxic properties of strychnine, and, manifesting themselves in a wholly 976
different manner, the still higher order of properties, including those of isomerism, exhibited by the proteine bodies; all of which we seem bound to ascribe to the respective orders of combination and complication, under which these substances, possessing the same elementary constituents, exist when they display these qualities. In short their properties must be regarded as the result of the respective molecular constitution of each substance.

With still higher states of aggregation, could such be conceived as possible, we should therefore naturally expect still higher forms of activity, still more marked properties. But we have learned that, while we may safely predict higher properties from higher degrees of aggregation, we have no basis whatever upon which to predict the nature of these properties. Not even in the simplest inorganic reagencies can we foretell the result of the union of any two elements. We cannot even say which of the three states of matter, the gaseous, the liquid, or the solid, our new compound will exhibit at our temperatures. The invincible solid, carbon, when joined with oxygen, becomes a gas; the type of gases, hydrogen, when combined with another gas, oxygen, results in a solid at 32° Fahr. Much less can we predict the other more special properties, even of these primary compounds. *A fortiori* is human prevision inadequate to presage the result of organic combinations. That the recompounding of the proteine bodies should result in a new form, possessing the quality of spontaneous movement, is *a priori* just as probable as that the addition of a molecule of oxygen should convert the hydrides into alcohols.

This complex stage of aggregation is no longer an hypothetical one. The molar aggregate resulting from such a recompounding of the albuminoids has been discovered. It exists under diverse conditions and manifests properties fully in keeping with its exalted molecular character. This substance, discovered by Oken in 1809, and by him denominated *Urschleim*, recognized by Dujardin in 1835, and called *sarcode*, and thoroughly studied by Mohl in 1846, who named it *protoplasm*, has now passed unchallenged into the nomenclature of modern organic chemistry under the last mentioned designation.

Protoplasm is a chemical substance, found in considerable abundance in nature, not only within the tissues of organ-
977 ized | beings, but, as we might almost say, in a mineral
state, wholly disconnected from such beings. There is no more doubt that it is a natural product than there is that ammonia is such a product. Its composition has been ascertained with considerable accuracy, and is found to be substantially the same under whatever form it may occur. According to the highest authorities this substance contains, approximately, fifty-four parts of carbon, twenty-one parts of oxygen, sixteen parts of nitrogen, seven parts of hydrogen, and two parts of sulphur in one hundred parts. These proportions doubtless vary somewhat, and traces of other ingredients may, perhaps, be occasionally detected, but the above description is sufficient to fix the chemical character

of protoplasm. To write its symbolic formula is impossible in the present state of science, but so is it still impossible to write that of the albuminoids with any reliable accuracy. Their numerous isomeric forms show us that the grouping of the molecules is subject to constant changes. This is doubtless true to a far greater extent of protoplasm. It is a substance whose molecular units are probably compounded of the units of the proteine bodies, which enter bodily into them in the same manner that oxygen and hydrogen enter into water, or, as we suppose ammonia, carbonic acid, and the compound radicals to enter into the more complex organic compounds.

The many conditions under which protoplasm is found to exist on the globe may, for convenience, be divided into two general classes: the free, and the dependent state. It is a matter of fact that it is found in a free state under a number of forms, both in the sea and in fresh water, and such bodies as Haeckel's Protogenes and Huxley's Bathybius are simply representatives of it in this condition. On the other hand, protoplasm is present in all organisms, whether animal, vegetable, or protist, and of which, though small in relative quantity, it constitutes by far the most important of all their material constituents. To distinguish the wholly independent, amorphous, and spontaneously developed form of protoplasm above described from that which is found in the tissues of organisms and inseparable from them, Professor Haeckel proposes to apply to it the term ***plasson***, or ***plasson bodies***, which, while it should not lead to the notion that there is any essential difference in the matter itself, is convenient to aid in retaining the conception, not generally acknowledged, of its purely chemical character. | It is, however, difficult to describe the
properties of the plasson bodies without giving rise to 978
the idea of life, since the leading one is that of spontaneous mobility, or motility, as it has been technically called. Anything that moves is naturally supposed to be alive, and if this were a test of life, all forms of protoplasm would be

living things. And, indeed, there would be really no objection to this view, provided the idea of life could be rigidly confined to this and a few other simple phenomena. But the tendency is always strong to couple with the notion of life that of *organization*, and few can be brought to recognize either that life can be the product of chemical organization, or that it can precede morphological organization. We are apt to associate with the conception of life, that of nerves, muscles, joints, limbs, stomach, and even sense organs. From the plasson bodies all these are as completely wanting as from a lump of gypsum. The spontaneous movements and all the transformations through which these substances pass, only constitute the mode in which their chemical activities manifest themselves. These activities belong to them in the same sense that sweetness belongs to sugar or astringency to alum. In fact, the primary distinction between these most complex of all known bodies, and the less complex ones, seems to be, that while in the latter all their activities are molecular, in the former they are to a certain extent molar, and carry with them the whole or a portion of the substances themselves.

The plasson bodies have recently been made to constitute a special field of scientific research, and, as much by accident as otherwise, it has been occupied by the biologists instead of by the chemists. These, like judges on the bench, have constantly ruled in favor of their own jurisdiction, and it is in this way that these substances have come to be regarded as forms of life, although their biographers have from the first insisted that they are not organized beings. Perhaps this bit of history is not unfortunate, since it teaches us to disconnect the ideas of life and organization in the biological sense, and thereby directs our thoughts towards the most profound truth, both of biology and of chemistry, which is that life is the result of the aggregation of matter. A plasson body performs all the essential functions of a living organism. It is capable of motion, nutrition and propagation. To these Professor Haeckel adds sensation,

for how can the other functions be conceived of without the
aid of this one. But we might almost as well ask, how can a
crystal grow without sensation. Nor has that great
naturalist failed to perceive these extreme conse- 979
quences of this extension of the biological jurisdiction, for
he seeks to escape them only by pushing it still farther, and
proclaiming the animation of all material atoms, even of
the lowest orders—*die Atom-Seele*. It seems far simpler,
as well as more correct, to recognize in protoplasm a true
chemical substance, but one whose properties constitute the
fundamental element of life.

Such a conclusion is no longer the bold speculation that it would have been pronounced a few years ago, and this paper could not be more fittingly concluded than with the words of Professor O. C. Marsh, uttered in 1877, that "if we are permitted to continue in imagination the rapidly converging lines of research pursued to-day, they seem to meet at the point where organic and inorganic nature become one. That this point will yet be reached, I cannot doubt."

137. What Mr. Ward was ready to say.

A Letter written at the request of Dr. E. L. Youmans on the occasion of the Complimentary Dinner to Herbert Spencer, Nov. 9, 1882, at Delmonico's, New York.

History.—On November 7, 1882, I received a letter dated November 5th, from Dr. E. L. Youmans, a portion of which was as follows:

"Excuse our lateness in sending you an invitation to our Spencer dinner. It promises well and if you can join us we shall be glad. But if not, pray send us a letter which may be read in whole or in part and printed in our "Proceedings" which will be issued in a neat form. I should greatly like to have you say in substance what you have so admirably said in your Chapter on Spencer in relation to his grasp of the principle of causation. I was much pleased with the insight of that recognition and the decisiveness with which it was presented. No one else will probably touch this matter, and it would be a point gained to have it fairly acknowledged. We are overdone with speakers or I might ask you to come on and speak to it. But even if you can come the letter will not be at all inappropriate."

I confess that I felt highly flattered by this invitation, and looked upon it as the highest honor I had ever received. I happened to be in financial straits, a note coming due that I could not see how to meet. The dinner was twelve dollars a plate, and the journey from Washington must be made if I went. I therefore at first blush dismissed the idea of attempting to go, and proposed to content myself with writing a letter. But the time was short and I must make haste to get a letter into Dr. Youmans's hands in time. I attacked it at once, and by two o'clock the following morning my letter was written.

To go or not to go was the question, and after an anxious night over it I arose in the morning fully resolved to go, and go I did. I took my letter with me and gave it to Dr. Youmans to make any use of, that he might see fit. He chose to include it among the "unspoken speeches," of which his own was the first and mine the second, there being only one other, that of Mr. Leland. Before the little booklet went to press, viz., on November 13th, I wrote the two concluding paragraphs, which were not in the original letter, and sent them on to Dr. Youmans to be appended to the letter as he then had it.

I do not know how I emerged from my difficulties, financial and other, but I never regretted that I attended the Herbert Spencer banquet. I have always regarded my decision to go as an example of the triumph of philosophy over the present, as well as over the past and the future, according to the celebrated maxim of Larochefoucauld: "La philosophie triomphe aisément des maux passés et des maux à venir; mais les maux présents triomphent d'elle."*

Herbert Spencer on the Americans and the Americans on Herbert Spencer. Being a full report of his interview, and of the Proceedings at the Farewell Banquet of November 9, 1882. New York, 1882, pp. 76–79.

HAD the master of the occasion then required Mr. Lester F. Ward, of Washington, to speak to the following sentiment, "*The True Philosopher—the highest Product of Evolution,*" Mr. Ward would have remarked:

Mr. Chairman and Gentlemen: There is a peculiar fitness in this testimonial to the great philosopher, now the guest of this country, and so soon to leave our shores. The occasion is certainly very distinct from nearly all others having the same external characteristics. The place you have selected is indeed famous for such entertainments, but too often they are given in honor of mere politicians. Such testimonials always involve the principle of a *quid pro quo.* The individual to be honored merely represents power to confer favors upon those who honor him. Admiration is moved by self-interest. Very different is the present occasion. The recipient of this honor holds his high position by virtue of what he has done. No political revolution or social cataclysm can ever shake it. His fame rests upon *ideas*, and as compared with ideas all other foundations are but sand.

Again, all must feel that it is not merely to a *man* that homage is being done; it is rather to a great *mind*—a mind that has proved itself capable of grappling successfully with

* Maxime XXII.

the profoundest problems of the universe. It is this brainpower, conceived to a large extent as | impersonal, that
we would recognize and honor. Mr. Spencer's per- 77
sonality is, as it were, swallowed up in his intellectuality. He represents no royal line of ancestors, bears no titles of honor from great states or great institutions, but occupies his present exalted place in the eyes of the world purely and solely through the force of his intellect. Unaided by human effort, and from the depths of his own mind, he has formulated the laws of the universe, not merely in the simpler and better known departments of astronomy and physics, but throughout the new and unexplored realms of life, mind, and action. It is to this achievement that we would do homage, which we do by honoring the man—the physical organization through which it was accomplished. Thus, at times, we find it difficult to think of him as formed of bone and sinew, flesh and blood, and contemplate him as the embodiment of psychic power.

For myself, I confess to the great force of this sentiment, occasioned perhaps by a long-continued habit of communing with his thoughts, always regarded as thoughts, and wholly disconnected from the character of their source; and this spell was scarcely broken by the warm grasp of his hand with which, but the other day, I was honored.

Mr. Spencer's preëminence as a philosopher rests primarily upon two qualities, and can only come of the union of these in one and the same mind. These qualities are, first, his extensive information; and, second, his extraordinary causality. The work of the true philosopher is preëminently the synthesis of extant knowledge. To accomplish this work he must possess, on the one hand, the greater part of the general knowledge of his age, and, on the other, the special faculty required to coördinate it. Rarely, indeed, are these qualifications combined in a single mind. It has been the misfortune of philosophy | that the most
of the truly logical minds have been deplorably lack- 78
ing in the necessary data upon which to exercise their

reasoning powers, while many of the minds that have taken pains to acquire extensive information have proved wholly incapable of making any rational use of it. We have, therefore, had logicians and speculators on the one hand, and erudites and specialists on the other.

When Mr. Spencer entered the literary world, the great demand of the age was a *synthetic philosophy*. He perceived this, and had the rare gift of seeing his own peculiar fitness for such an undertaking. This duty seemed to devolve upon him; he accepted it, and no one has been found to challenge his qualifications to perform it. His mastery of all branches of human knowledge has been justly styled "encyclopedic." His causality has never been equaled. To him were thus secured the two essential conditions for accomplishing the permanent object of philosophy—the synthesis of science. Without the comprehensive survey which his laborious investigations have secured for him, his great combining powers would have been profitless; without those powers, no museum of facts, however well learned, would have yielded the broad principles of a cosmical philosophy. Of the former of these statements, not only all the great minds of antiquity, but such modern names as those of Kant and of Hamilton, are obvious examples; while of the latter the life of Humboldt is, perhaps, the most conspicuous proof; although, within more restricted limits, the scientific world offers a multitude of instances in which the capacity for observation vastly transcends the power of coördination.

In his grasp of other truths Mr. Spencer has not failed to comprehend this one. It is he himself who has said (and both the language and the thought belong to the anthology of our tongue) that "only when Genius is
79 married to Science can the highest results be produced."
And, if we rescue the word *genius* from that bastard synonymy with *monomania* to which modern usage threatens to condemn it, we find that in him these two fertile attributes are united with all the constancy and sanctity of wedlock.

If I might be permitted to hint at the precise direction from which Mr. Spencer's great labors most strongly appeal to my mind, I should do so by intimating the possibility that he himself may fail to appreciate their full scope and influence. Emerson, one of whose wise sayings Mr. Spencer has embodied in his own remarks, has said of the world's greatest artist that—

"He builded better than he knew."

May it not be that the world's greatest philospher has also "builded better than he knew"? May it not be that in telling us what society is, and how it became such, he has unconsciously pointed out the way in which it may be made better? In laying down the principles according to which social phenomena take place in nature, may he not have rendered possible, in the near future, some practical applications of those principles to higher social needs? I venture to predict that, in thus building the *science* of *Sociology*, Mr. Spencer has prepared the way for the introduction, on the basis of that science, of the corresponding *art* of *Sociocracy*.

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138. Captain C. E. Dutton on the Hawaiians

History.—Written January 3, 1883. Captain Dutton spoke without notes, and I took his remarks down, as I had been in the habit of doing while so long secretary of the Society. I had declined re-election a short time before, but I knew my successor would not report the proceedings as I had been doing.

Science,* Cambridge, Massachusetts, Vol. I, No. 1, February 9, 1883, p. 9.

CAPTAIN DUTTON of the United States Army has just returned from a sojourn of seven months on the Hawaiian Islands, where he went for the purpose of studying the volcanic phenomena. Although most of his time was necessarily devoted to geological investigation, he yet found time to collect a large mass of ethnological data, which he presented in a most interesting form at a meeting of the Anthropological Society of Washington, held Jan. 2.

He said that in color the inhabitants are of a bronze shade about midway between the color of the North American Indian and the Malayan. The general features, however, are very unlike those of our Indians, and partake in part

* See No. 106, Vol. II, p. 271.

of the character of the European and in part of that of the African tribes, though more strongly of the former. In stature the Hawaiians are large, and equal the Anglo-Saxon race. There are, however, two broadly marked social castes, and these differ physically almost as widely as they do socially. The ruling class are lighter in color, and larger in stature, being usually above six feet in height, and sometimes reaching six feet seven inches. They also tend to obesity, and are readily distinguishable from the lower classes in numerous other ways. The Hawaiian Islanders belong to the finer and better of the two great races of men which about equally share the Polynesian Islands. They were never cannibals, and nothing offends them more than the charge of having eaten Captain Cook.

Many facts point to the East-Indian Archipelago as the portion of the globe from which these people originally came; and among these evidences are their possession, when first seen by Europeans, of the dog, the pig, and the domestic fowl, none of which could have come from America. Their language allies them very closely to certain Bornean tribes, and particularly to the Dyaks. This affinity is especially observable in their numerals.

Their legendary lore, which is amazingly rich, also belongs to the East-Indian type, and even partakes in a striking manner of the character of that of India, Western Asia, and Egypt. Their myth relating to the creation of woman is identical with that in Genesis, and may have been borrowed from the early missionaries; but against this view is the remarkable fact that it appears in an archaic form of their language which only the priesthood can fully understand. The present king Kalakaua is much interested in the ethnology of his people, and believes in their American origin—a belief which the speaker did not share.

The population of the Hawaiian Islands is dense, and everything points to the conclusion that this has been the case for a very long period. The arable lands are confined to belts around the islands extending inward from six to twelve miles to the beds of lava or steep sides of the mountains. These lands are divided up into very small lots by means of stone walls.

The state of society is by no means low or savage. Society is well organized according to a rigid system. This system very closely resembles the feudal system of European history, having all the classes which characterized that system. Prior to the consolidation of all the governments of the islands by Kamehameha I., in the early part of this century, there existed on each island a number of independent kingdoms. The kings were the proprietors of all lands, which they parcelled out to subordinate chiefs, whose tenure was strictly analogous to enfiefment, with this exception, that, in addition to homage and military service, tribute was also exacted of them. The latter subdivided their fiefs among their retainers on similar conditions, and these turned them over to the lowest, or working classes, to cultivate; which latter were the true *villeins*, who were merely tenants at will. Still this latter form of tenure was the most permanent; since the chiefs were liable to be changed by military reverses and royal displeasure, while the *villeins* remained, as in Europe, practically *adscripti glebae.* The priesthood was almost always found supporting the king. This class maintained, down to the reign of Kamehameha II., the most despotic sway over the people, and chiefly through the principle involved in the terrible word *tabu.* The fundamental idea underlying this term is *divine prohibition*, and the penalty for the breaking of a tabu was always death. The people submitted to this in the firm belief that death in some form was certain to follow such offences; and that, if man did not inflict it, the gods surely would. Tabus were either permanent, recurrent, or merely temporary and arbitrary. Among the permanently tabued acts was that of the sexes eating together. Special tabus were prescribed by the king, with the advice of the priesthood.

The speaker went on to describe in detail the mode of subdividing the land for agricultural purposes, the skill displayed in irrigation, the principal products of the soil, the leading articles of food and how they are prepared, the character of the houses, the manufacture of tappa-cloth and of mats out of the screw pine, the culinary utensils and dishes used; the implements manufactured and the materials yielded by the country for these purposes; the modes of fishing; the kind of dress worn; the elaborate robes, cloaks, helmets, etc., made for the kings, of yellow and red feathers; and the use of nuts as candles. He further treated of the military tactics of the Hawaiians, and the arms employed; of their canoes, and mode of navigation, by which they have frequently visited the Society Islands, a distance of 2,400 miles. They knew much of astronomy, and possessed an accurate calendar, dividing their year into twelve months of thirty days, with allowance for the bissextile. Their year begins at the time when the Pleiades rise at sunset. They count to millions, with names for all their numbers. The priests know every plant on the islands, and are especially familiar with their toxic properties. Interesting remarks were made on their language, their mythology, and their religion. Legends and royal pedigrees are handed down with great exactness by a special class who make this their only business. The language of their classic lore is archaic, and unintelligible to the common people. The genealogy of kings is traced back a hundred generations. Descent is here in the male line, but descent of property among the other classes is in the female line. This is rendered necessary from the fact, that with the exception of the queen, who is *tabu* and therefore chaste, chastity in women is regarded as a disgrace, in that it denotes a want of attractions. Monogamy prevails, but divorce is easy and sexual morality excessively lax. The dead are buried in caves in the mountains, in a sitting posture. Until recently human sacrifices were of frequent occurrence. Criminals are executed secretly with a club. Walled enclosures constituted their "cities of refuge."

Their temples in the form of parallelograms were also described.

Captain Dutton closed his remarks by rapidly glancing at the influence of the missionaries, and the modern innovations and modifications in Hawaiian society.

139. The Postage Question

History.—These letters explain themselves. It is a vexed question which has never been satisfactorily settled.

The Botanical Gazette, Crawfordsville, Indiana, Vol. VII, Nos. 8 and 9, August and September, 1882, pp. 97–99.

WASHINGTON, D. C., July 1, 1882.

EDITOR BOTANICAL GAZETTE:

Dear Sir—The note of Mr. Trelease on "The Postage on Botanical Specimens," published in your June number (p. 73), still leaves the question open as to what kind of labels will be allowed to go with the specimens, many supposing|that so far as botanists are concerned, the
old liberal ruling is still in force, and that the statement 98
on page 234 of the "Guide to the Flora of Washington and Vicinity," was wholly incorrect. While for one I should only be too glad if this were the case, I still presume that the chief desire of all botanists is to know precisely how the laws are construed by the Post Office Department at the present time, and with this object in view I have not only revisited the Department, but have corresponded officially with it, and if not trespassing too largely upon your columns, I would be glad to have the correspondence published. It seems to cover the whole ground and may render further inquiries unnecessary.

I desire to say, however, in advance, that the statement in my flora was too strong and really inaccurate, and especially, that the word "third-class" was an error for *fourth-class*, which was overlooked in reading the proof.

Very truly yours,

LESTER F. WARD.

NATIONAL MUSEUM.

WASHINGTON, D. C., June 21, 1882.

HON. TIMOTHY O. HOWE, Postmaster-General:

Sir—I enclose a leaf from Bulletin, No. 22, of the National Museum, of which I am the author, upon which [p. 234] are marked passages relating to the sending of written labels with botanical specimens.

Since the publication of the Bulletin the Department has been asked whether the statements therein were correct, and has replied by sending copies of the Postal regulations of February 21, 1881, and calling special attention to the 7th exception by underscoring the word "name" on the last line but one, which action has been published in the BOTANICAL GAZETTE (June 1882, p. 73).

The impression seems to prevail that this exception will apply to botanical labels made out in the usual way, of which three samples are inclosed within.

As labels without *authority*, *locality*, or *date*, are of no scientific value it is supposed that these would be construed as necessary "for purposes of identification" and therefore legal.

You are respectfully requested to state whether the Department so construes the regulation, and if not, to indicate such portions of the inclosed labels as would be illegal, and to return the same for the information of the profession, who, rest assured, need only to know the law in order to comply with it.

Very respectfully,

Your obedient servant,

LESTER F. WARD.

Post Office Department,
99 Office of First Ass't Postmaster General,
Washington, D. C., June 24, 1882.

Lester F. Ward, Esq., National Museum,
Washington, D. C.:

Sir—Your communication of the 21st inst., addressed to the Postmaster General, has been referred to this office for reply.

The labels submitted by you, so far as they contain simply the name of the plant, and as necessary to fix that name, the name of the person making the classification, adding, as part of the name, the variety, and the name of the person classifying, will be held to be within the language of the Statutes. But it is impossible, by any fair construction, to authorize a statement of the kind of soil in which the plant grows, or the locality from which it comes, or the date at which the plant is obtained, or the date at which it flowers, or yields fruit.

All these descriptive matters might be placed upon the label, by the use of a gelatine pad, thus making a reproduction of the matter; or, by the use of a hand stamp. You are respectfully referred to Rulings 319 and 320, January Postal Guide, 1882, page 719, a copy of which guide will be sent to you, through the Post Office.

Your labels and communication are respectfully returned.

Very respectfully,

E. C. Fowler,
For First Assistant Postmaster General.

140. Decumaria barbara

History.—Written July 1, 1882. I should have said that as our previous visit to the Dismal Swamp was made before the middle of May the flowers were then immature.

Ibid., pp. 99–100.

ON May 29th of this year, in company with Dr. Frank Baker, I paid a brief visit to the Dismal Swamp of Virginia. My principal object was to find if possible that handsome vine, *Decumaria barbara*, L., which I had seen in the swamp in 1876, when, in company with Professor Chickering and Mr. Morong, I had enjoyed a three days' sojourn in that wilderness of amber-colored waters.

As on that occasion the plant was not seen till we had penetrated far into the swamp on what is known as the Jericho Canal to near the open lake, and as on the present one, starting from Bowers Hill Station on the Seaboard and Roanoake R. R., we could only find ditches that would lead us in a distance of about two miles, we were by no means sanguine of success. But successful we were, and found many large and beautiful vines climbing the great gum trees. They were in full bloom and the problem was to reach the flowers.

As your readers probably know, this vine climbs by means of fine rootlets, after the manner of *Rhus Toxicodendron*, which it much resembles in many other respects, and with which it vies in the Dismal Swamp for the possession of the finest supports. To climb to the lowest flowering branches was impossible, and after reaching the verge of despair, the thought struck us of severing a|vine at the base, and, 100
by detaching it for a long distance from the tree to which it clung, to bring down, if possible, the flower-bearing portion. Though a barbarous proceeding we nerved ourselves to it and our efforts were crowned with abundant success.

This plant, as your readers all probably know, is not described in Gray's "Manual" fifth edition, but whether its discovery in the Dismal Swamp in 1876, on the occasion above mentioned, was its first appearance north of the southern boundary line of Virginia, I do not know. However that may be, I thought it might interest some to know that it had been found at the northern border of the swamp and within ten miles of Norfolk.

141. Proterogyny in Sparganium eurycarpum

History.—Written June 27 to July 1, 1882.

Ibid., p. 100.

IN a marsh near the Eastern Branch of the Potomac I found a few days since the finest patch of *Sparganium eurycarpum* that I ever saw, the developed white blossoms being conspicuous from a distance. On approaching and examining them I perceived that the plant was very obviously proterogynous. The two distinct states were so clearly marked that they gave the appearance of two kinds of plants. Those on which the fertile heads were developed and the stigmas ready to receive pollen invariably had all the staminate heads undeveloped, while those in which the staminate heads were developed had in all cases commenced to form fruit. Still a third state occurred in which anthesis was entirely past in both kinds of heads and large heads of fruit had formed. While the order of development of the pistillate and staminate heads was always the same, abundance of plants existed in both states, so that fertilization was possible, yet a careful search failed to reveal a single plant in which the time of expansion of the male and female flowers was synchronous—*i. e.*, in which self-fertilization could have taken place.

142. Plant-life, Past and Present

History.—Written March 25–31, 1883. This is the first abstract I prepared of my lecture on "Plant-life of the Globe, Past and Present," delivered on February 24, 1883. I had made elaborate preparation for the lecture, and it was illustrated by five large charts hung on the walls. The outline of the lecture was written from January 1st to February 8th, and it was rewritten in the form in which it was delivered before the date of delivery on February 24th. The charts, with one exception, were substantially the same, greatly enlarged, of course, as those of my *Sketch of Paleobotany*, published two years later in the Fifth Annual Report of the U. S. Geological Survey (see No. 208). In fact the lecture was the basis of that paper, which I then proceeded to complete. The one chart not included in that paper was an attempt to represent the evolution of plants by a genealogical tree.

The great labor consisted in preparing the numerical table. As soon as I entered upon my duties as paleobotanist of the Survey in 1881, I saw that while a vast amount of data existed for the study of the geological history of plants, it was not in a condition to be used in reaching any safe conclusions. I therefore proposed to the Director to prepare a *Compendium of Paleobotany*, from which to obtain general results. But I saw that it would involve immense labor in cataloguing the literature. The plan of the *Compendium* was fully set forth in my *Administrative Report* for the year ending June 30, 1884 (see No. 207), in the same volume as the *Sketch of Paleobotany*, which was treated as the introduction to the *Compendium*. The scheme was never carried out, the only other contribution made to it being my *Geographical Distribution of Fossil Plants* in the Eighth Annual Report of the Survey (see No. 263), but the work of cataloguing was continued till 1905, and reached a high state of perfection.

Science, Cambridge, Massachusetts, Vol. I, No. 13, May 4, 1883, pp. 358–359.

THE opening lecture of the second course of 'Saturday lectures,' delivered at the National museum in Washington, was by Mr. Lester F. Ward, assistant geologist U. S. geological survey, and honorary curator of fossil plants to the museum; the subject being 'Plant-life of the globe, past and present.'

The object of the lecture was to give some account of the progress which has taken place toward the adoption of a truly natural system of botanical classification. After describing and comparing the methods of Linné, of A. L. de Jussieu, of Adrien de Jussieu, and of modern botanists, the lecturer pointed out the objections which may be made to all of these, and then presented the outline of a system which aimed to exclude the objectionable features, and to accord with the results of the latest discoveries in structural botany, and especially with the teachings of paleontology, which he claimed to have been too much ignored by botanists. The proposed system was as follows:

- Cryptogams.
  - Cellular.
  - Vascular.
    - Filicineae . . . .
      - Filices.
      - Rhizocarpeae.
    - Lepidophytae . . .
      - Equisetineae.
      - Lycopodineae.
      - Ligulatae.
- Phenogams.
  - Gymnosperms . .
    - Cycadaceae.
    - Coniferae.
    - Gnetaceae.
  - Angiosperms . .
    - Monocotyledons.
    - Dicotyledons.
      - Apetalae.
      - Polypetalae.
      - Gamopetalae.

The claims of this scheme as the nearest approach yet made to the system of nature were supported, for the most part, on paleontological grounds. To do this, an elaborate chart was presented, giving the geological history of each of the principal types of vegetation. This was in the form of a tabular exhibit of the number of species belonging to each type, which have been found fossil at each geological horizon, and also the most reliable estimates that could be obtained of the number living at the present time in all parts of the world. It also showed the percentage that each type formed of the total known flora of each epoch. We give below a condensed view of this chart, which is all we have space to present.

Relative to this table, it should be explained,—

1. That the figures given for the living gymnosperms

and dicotyledons are, in round numbers, those of Messrs. Bentham and Hooker, as stated for each genus and order in the 'Genera plantarum,' and which are here compiled, perhaps for the first time.

2. That the number of fossil species were collated from a great number of sources; Schimper's *Traité de paléontologie végétale* being the basis, supplemented by data from all the more recent publications which were accessible, and by some unpublished data. Absolute completeness, however, was not claimed, but only such substantial accuracy as was deemed sufficient for the purposes of the lecture.

3. That under 'tertiary time' are included all the beds from the quaternary to the middle cretaceous; the latter being represented in this country by the Dakota group, and in Europe by the cenomanian. This is done because it is at the last-named horizon that the dicotyledons first appear, and because they appear here in such extraordinary profusion. Marquis Saporta has also made the vegetable tertiary to begin at this point.[1]

The facts embodied in this table were further graphically illustrated by two diagrams, prepared by Ensign E. E. Hayden, U.S.N. The first of these showed, by means of accurately plotted curves and colored areas, the development of each type of vegetation through the several ascending strata, the breadth of the areas at any epoch representing the prominence of the several types relatively to the entire flora of that epoch. The other diagram consisted of a |series of independent figures, designed to show the
359 degree of development attained by each type at any epoch relatively to other epochs.

These charts and diagrams were thoroughly discussed; and the lecture closed with a few remarks on the genealogy of plants, illustrated by an arborescent figure showing one of the possible ways in which the present forms of plant-life may have been derived.

[1] *Le monde des plantes avant l'apparition de l'homme*, p. 160.

NUMBER OF KNOWN SPECIES OF FOSSIL AND LIVING PLANTS.

Geological periods.	Cryptogams.						Phenogams.							Total.
		Vascular.					Gymnosperms.			Angiosperms.				
											Dicotyledons.			
	Cellular.	Ferns.	Rhizocarpeae.	Equisetineae.	Lycopodineae.	Ligulatae.	Cycadaceae.	Coniferae.	Gnetaceae.	Monocotyledons.	Apetalae.	Polypetalae.	Gamopetalae.	
Present time	35,000	3,000	100	30	500	400	75	300	40	25,000	12,000	35,000	40,000	151,445
Per cent	23.10	2.00	0.05	0.01	0.32	0.25	0.04	0.20	0.02	16.50	8.00	23.10	26.41	
Tertiary time	302	202	7	27	2	5	19	253	3	446	1,285	1,650	499	4,700
Per cent	6.43	4.30	0.15	0.57	0.04	0.11	0.40	5.38	0.06	9.49	27.34	35.11	10.62	
Secondary time	112	298	1	33	1	..	198	90	..	19	..	..	..	752
Per cent	14.89	39.63	0.13	4.39	0.13	..	26.33	11.97	..	2.53	..	..	..	
Primary time: Carboniferous	19	664	3	81	298	..	67	54	..	..	..	..	..	1,186
Per cent	1.60	55.99	0.25	6.83	25.13	..	5.65	4.55	..	..	..	..	..	
Primary time: Devonian	29	35	..	4	16	..	5	5	..	..	..	..	..	94
Per cent	30.85	37.23	..	4.26	17.02	..	5.32	5.32	..	..	..	..	..	
Primary time: Silurian	19	1	..	2	2	..	1	..	..	..	..	..	..	25
Per cent	76.00	4.00	..	8.00	8.00	..	4.00	..	..	..	..	..	..	

143. [Notice of Dynamic Sociology]

History.—Written March 1–29, 1883. On January 24, 1883, I received a request from Dr. E. L. Youmans to write for the *Popular Science Monthly*, a somewhat extended notice of *Dynamic Sociology*, soon to be issued. The rough draft, which I still possess, was finished on March 24th. It was rewritten and may have been somewhat changed. As it appeared on May 16th it differs considerably from this rough draft. The first three paragraphs are not mine at all, and other parts have undergone verbal changes, still, the bulk of the matter is substantially as I submitted it.

The Popular Science Monthly, New York, Vol. XXIII, No. 2, June, 1883, pp. 273–276.

DYNAMIC SOCIOLOGY, OR APPLIED SOCIAL SCIENCE, AS BASED UPON STATICAL SOCIOLOGY, AND THE LESS COMPLEX SCIENCES. By LESTER F. WARD, A.M. In two volumes. New York: D. Appleton & Co. Pp. 726 and 698. Price, $5.

IN the rush of publications from a teeming press there now and then comes a work of such grave and exceptional import as to demand a special and careful consideration, and among these are to be included the two comprehensive volumes now before us. Under the technical and somewhat unattractive title of "Dynamical Sociology," Mr. Ward has made an original and able contribution to the large and very important subject of social science. Although he is, of course, indebted to many sources for his materials, yet the handling of the topics is his own. His work is not a compilation or *résumé* of previous promulgations, but an elaboration of his own independent views; and he has constructed a system which, from its breadth, its scientific basis, and its elaborate method lays claim to the character of a philosophy.

It must be confessed that the presumptions in these times are strongly against the novel and ambitious reconstructions of thought which so frequently challenge public attention, and, if the author were asked in this case for his credentials, he would probably say that they must be found in the book. Yet Mr. Ward is well-known by his scientific, economical, and social contributions to the magazines, as well as by other publications of recognized merit, and if he has not before issued any considerable book, it is probably because he has been absorbed for the last ten years in the preparation of the extensive treatise now published.

Mr. Ward's title, as we have intimated, is unfortunate. Sociology is a forbidding word—snarled at by petty purists as illegitimate—and not yet settled and defined in familiar speech; while the kind of sociology designated as "dynamical" only deepens the obscurity, and makes it necessary at the outset of any intelligible notice of the work, to explain what is meant to be indicated by these terms. This will, moreover, furnish the key to the method of the book.

The author assumes sociology to be a science already so well established as to take proper rank in the family of sciences. It deals with the laws of social phenomena, as botany deals with the vegetable kingdom, and zoölogy with the animal world. But science is of two kinds, pure and applied, the former consisting of an exposition of facts and principles, and the latter of their practical applications for purposes of utility. Pure sociology, therefore, confines itself to the classification of the facts and the elucidation of the principles of social phenomena. It deals with society by the natural history method, describing, analyzing, comparing, and generalizing the comprehensive data of the subject. Its aim is simply the establishment of a body of truth, without the formal consideration of its uses. This is sociology as generally and properly understood.

But Mr. Ward thinks that, when the practical applications of this science are to be considered, new terms are needed to mark an important distinction, and so he uses the word *statical* to characterize its common scientific form. But this established sociology, or "Statical Sociology," which consists of the classified facts and generalized prin-
274 ciples of the science, he holds to be of a negative or passive kind, and he says that this has hitherto proved sterile or unproductive of benefit to the community. Like the other sciences, it needs application to make it useful and valuable. But this application involves active human agency, the control of social effects, and, as man's effort and directive power is here the main idea, he expresses this element of force by the term *dynamic*, and calls this branch of the subject "Dynamic Sociology." On this view, statical sociology deals with the great processes of nature, with genesis and natural evolution; while dynamic sociology treats of psychic human agency, and artificial results in the social sphere.

Mr. Ward maintains that the time has come when sociology must pass formally from the theoretic to the applied stage. While admitting the impracticability of most of the measures that have aimed at social amelioration, he nevertheless considers that we can no longer avoid the endeavor to derive certain fundamental principles of social action that shall bring the phenomena of society under the same intelligent control that science has long made possible in the division of physical phenomena, and guide the active interference of man in the direction of social affairs and to the accomplishment of social ends. This he assumes to be the art stage in the development of the subject in which purposed artificial agencies supplement and carry forward the natural processes of development for the attainment of the highest fruits of human progress.

Mr. Ward devotes his first volume mainly to "Statical Sociology." It opens with a long introductory chapter, presenting a general view of the entire scheme. This is followed by two historical chapters, reviewing the two great modern systems of Auguste Comte and Herbert Spencer, in a manner sufficiently full for his general purpose. Then follow four chapters dealing with the most fundamental principles of cosmical development, or evolution in the domain of purely natural phenomena. These are entitled respectively "Cosmogeny," "Biogeny," "Psychogeny," and "Anthropogeny," dealing with the genesis of worlds, of life, of mind, and of man, and naturally leading up to the higher department of "Sociogeny," or the genesis and development of human society. Following the current terminology, we have here to do with pure sociology only, or its treatment from the point of view of the laws of nature. As a comprehensive exposition of the doctrine of evolution, this volume has great merit.

Sociological study thus far, Mr. Ward maintains, has chiefly given attention to the genetic or unconscious progress of society. The causes that have produced this passive or unconscious social progress are subjected to a searching analysis, and are found in the *social forces*. These consist fundamentally in desires, but they are desires which inhere permanently in the nature of man as a living organism. They are divided into two great groups, the original, or essential, and the derivative, or non-essential, social forces. The essential forces are those desires which belong to man as an animal, and are necessary to the maintenance of the primary functions of nutrition and reproduction. The non-essential forces are those desires which have been developed in the course of evolution, and they are divided into the æsthetic, the emotional or moral, and the intellectual social forces. The primary forces, which have led to social transformations, are, therefore, blind forces, which result in the performance of acts with no reference to their ultimate effects.

Mr. Ward's argument for dynamical sociology, to which his second volume is devoted, is not easily presented in a paragraph, but it is substantially as follows: The ultimate end of human action is well-being or *happiness*, but this can not be attained through direct effort; it requires means. There are five proximate ends standing in as many degrees of remoteness from the ultimate end, the attainment of any of which is equivalent to the attainment of all the less remote ones, and the ease in securing which is directly proportional to their remoteness. These proximate ends, therefore, constitute so many means to the attainment of the ultimate end of well-being.

The first of these proximate ends is human progress itself, which, in order to be true progress, must secure the ultimate end. But progress is not in any proper sense at|tain-
275 able by direct effort; it must itself be sought through means. The means of progress, which therefore become the second proximate end, must consist in the proper kind of *action*, but such action is only less difficult of direct attainment than is progress itself. Here, again, the necessary means must be adopted to secure the end.

The higher forms of action, such as seriously affect the condition of society, are chiefly the result of the ideas or opinions entertained. In a general sense, then, *opinion* may be regarded as the means to action, and hence as the third proximate end. But direct attempts to influence opinion are also practically futile; means must be employed here, as before.

Ideas and opinions rest upon the data in possession of the mind. Such data, to conduce to the several proximate ends, and through these to the ultimate end of well-being, or happiness, must be in harmony with reality. In other words, the data of opinion must consist in *knowledge*. Knowledge, therefore, is the fourth proximate end, the attainment of which will carry with it that of all the less remote ones, and also that of the ultimate end. Now, knowledge may be attained by the direct effort of the individual; but the mind is most receptive of it during the plastic period of youth, before an appreciation of its value can have been acquired sufficient to insure the effort to obtain it. To leave it to enforce itself, therefore, is virtually to fail of its attainment, so that this also is to be secured only through means.

The means to knowledge is instruction or *education*. This is defined as "the universal distribution of the most important extant knowledge." As an end, education can be easily secured by direct effort, even of society in its collective capacity. It differs from all the other ends in requiring no further means for its accomplishment than the mere mechanical appliances. Education, therefore, constitutes the most remote proximate end, and the *initial means* to the attainment of all the less remote ends, and also of the ultimate end of the general welfare. All these ends may, therefore, be wholly neglected and left to take care of themselves, and the entire energy of society may be concentrated upon this most remote end, or initial means, to the highest social progress.

The second volume of Mr. Ward's work opens with a chapter treating chiefly of man's relation to the universe, which he insists must be more clearly conceived before any further progress can be made in philosophy, and it ends with a statement of the definitions and theorems of dynamic sociology. The remaining six chapters are devoted to the detailed consideration of the six theorems, one being given to each of the great ends, in the order in which we have noticed them. The work, therefore, closes with a radical discussion of the claims of education as above defined, as the supreme essential condition to further and higher social progress.

No idea can be given in such a brief notice as this of the number of important subjects of great public interest at the present time that are traversed by Mr. Ward in these solid volumes. The work is more constructive than critical, but it deals throughout with live topics and urgent public problems. The author takes radical issue with his philosophic predecessors, and arrives at new results for which he claims the sanction of science and reason. As the reader will perhaps have inferred, the drift of his reasoning is toward a great extension of coercive agency and government control in the work of social progress. His work is, in fact, a vigorous and systematic assault upon the doctrine of *laissez faire*, and the policy of leaving things to spontaneous influences and the self-regulation of private enterprise. It is, perhaps, the strongest defense yet made of the enlargement of state functions for the direction of social affairs. The task was an ambitious one, but the manner of its execution proves that it was not presumptuous.

The merits of Mr. Ward's work are unquestionably such as to entitle it to the serious attention of students; but, aside from its intrinsic claims, its logic is so strongly in the direction of predominant American tendencies, that it is sure to be welcomed by many as a representative exposition of American policy and thought. It appeals strongly to different classes of thinkers. Boldly coping with the ripened systems of the Old World, it will commend itself to many
276 who are ambitious about the development of philosophy on this side of the Atlantic. The work is, moreover, of an eminently practical sort, and deals with the relations of political and social science in their bearing upon the interests of the community in such a way as to entitle it to the consideration of statesmen and political economists. Besides, as it offers a new synthesis of facts, and aims to coördinate into a uniform scheme the accepted truths of all the sciences, it can not fail to awaken the interest of thinking scientific men in all departments. And, as the philosophy of re-

ligion is broadly and independently treated, the work is certain to have an interest for all schools of religio-philosophic speculation and inquiry. As Mr. Ward's work is thoroughly up to the times both in substance and spirit, the reader will of course be prepared for a good deal of f eedom and boldness in discussion; but the author is no trifler, though, in the courageous expression of his convictions, he goes no further than is justified by the practice of this questioning age.

We may add that the work is written in a style that will commend it to popular readers. Mr. Ward makes himself perfectly understood, and without effort on the part of those who follow him. He is at times diffuse, and we think the work would have borne considerable condensation, but, believing that the views he desires to promulgate are important, the author seems to have been only solicitous for that fullness of statement that shall give completeness to his meaning in the reader's mind. The references to collateral discussion are numerous throughout the text, so as to facilitate the following out of any special argument, and the index to the work is careful and exhaustive. Mr. Ward has been arduously occupied upon his treatise for a long time, and may be congratulated upon the perfection of its form as a product of the book-making art.

It has been our purpose in this notice simply to give the best account we could in so brief a space of the general characteristics of the "Dynamic Sociology." Our readers hardly need to be reminded of our decisive dissent from the doctrines of the school of which Mr. Ward will now easily take the place of the ablest leader, but we have refrained from criticism, that our statement might be as far as possible fair and unbiased. There is, at any rate, a great deal in this work that is instructive, and to be cordially commended, and there are parts of it that we could wish to see more widely circulated than they can be in these formidable volumes. Though disagreeing with much that it contains, the book is nevertheless to be welcomed as a timely contribution to contemporaneous inquiry, and it will unquestionably aid in giving a fresh impulse and a fruitful direction to the discussion of large and momentous subjects.

144. Bibliography for 1881.

History.—Written January 17, 1882. All the members of the staff of the Smithsonian Institution and National Museum were requested to furnish for each Annual Report a list of the papers they had published during the year. My connection with the Institution began in May, 1881. Brief summaries of the contents of the papers were uniformly appended.

Annual Report of the Board of Regents of the Smithsonian Institution for the year 1881. Washington, 1883, pp. 124–125.

WARD, LESTER F.—Evolution of the Chemical Elements.

(Popular Science Monthly, February, 1880, pp. 526–539.)

A discussion of the theory of development as applied to the elements and consideration of the facts recently revealed by spectrum analysis seeming to favor the theory.

Previously read before the Philosophical Society of Washington.

—— Incomplete Adaptation as illustrated by the History of Sex in Plants.

(Amer. Naturalist, February, 1881, pp. 89–95.)

Read before the Biological Section of the American Association for the Advancement of Science at Boston, August 27, 1880.

The paper shows that there exist, in nearly all departments of the vegetable kingdom, successive degrees to which the process of sexual differentiation has attained, and that in many cases there are obvious indications that this process is still going on.

125 —— Pre-Social Man.

(Abstract of Transactions of the Anthropological Society of Washington, for the years ending January 20, 1880, and January 18, 1881, pp. 68–71, being the abstract of a paper read before the Society April 20, 1880.)

The anatomical characters distinguishing the human form from that of the most highly developed anthropoids are enumerated, and the several physical causes considered which seem to have been most potent in securing their development.

—— Savage and Civilized Orthoëpy.

(Loc. cit., pp. 106–111 being the abstract of a paper read before the Society December 21, 1880.)

This paper consisted principally of remarks and strictures on the first chapter of the *Introduction to the Study of Indian Languages*, by J. W. Powell, Ph. D., Director of the Bureau of Ethnology, which treats of the pronunciation of Indian and other languages.

—— Politico-Social Functions.

(Penn. Monthly, May, 1881, pp. 321–336. Read before the Anthropological Society of Washington March 15, 1881.)

The right, power, and duty of society to regulate its own operations are argued, and the progress which has taken place toward this end in various countries is reviewed.

—— Field and Closet Notes on the Flora of Washington and Vicinity.

(Bulletin of the Philosophical Society of Washington; 1881, vol. iv., pp. 64–119. Read before the Society January 22, 1881.)

The paper embraces, among other sub-titles, a *Comparison of Flora of* 1830, *with that of* 1880; a description of the *Localities of Special Interest to the Botanist;* a consideration of the *Flowering-time of Plants;* a *Statistical View of the Flora* as compared with other floras; an enumeration of the most *Abundant Species;* a statement of the most approved *Classification Adopted* by botanists; remarks on *Common Names*, and a *Summary* by Orders and larger groups of the number of genera and species found growing in the vicinity of Washington.

145. Dynamic Sociology, or Applied Social Science, as Based upon Statical Sociology and the Less Complex Sciences. In Two Volumes. New York: D. Appleton and Company, 1883.

History.—Written June 18, 1869, to March 15, 1883. It will be seen in the account that I am about to give that these intralimital dates must be taken in a very general sense, but they do correctly represent the beginning and the end of my actual writing, albeit much that I wrote, and notably all written during the first three and a half months, never found its way into the book as printed. Not only this, but later on more than two years were largely spent on a great chapter that was finally excluded and still remains unpublished. Still it all has to be counted in the *tout ensemble* of the work.

In writing this historical sketch of my first work, covering so long a period of my early life, I cannot of course rely upon my memory. Fortunately I am not obliged to do so. My main dependence is my diaries. I have kept a daily record of my life from the age of nineteen. For the first ten years it was chiefly written in French, very bad French of course. The object of this was not to air my French, for no one saw it, nor wholly for practice, though this was a part of it, but chiefly for privacy, as it began with my courtship in a rural community where no one could read it; and it served this purpose admirably. But it was continued long after my marriage, chiefly for practice.

In all my early life I was always thinking on the deeper problems of nature and of man, and in various debating clubs I often ventilated my views. It always seemed to me that the last word had not been said on many of the most vital of these, and I instinctively inclined to express my own thoughts. I also wrote a good many academic papers in which I did express some of them. But I had the feeling, common to many young men, that what was called an "education" was a condition precedent to any serious effort. I do not know when I became fully resolved to begin some systematic work as soon as I should receive my first degree, but I know that I long carried that resolution with me. When at last that consummation was approaching in the last semester of my collegiate course, this sentiment took a firm hold of me and found expression not only in my diary, but also in some pencilings which are happily preserved.

Perhaps the most vivid impression that my early experience left on my mind was that of the difference between an uneducated and an educated person. I had had much to do with both these kinds of people, especially with the uneducated, and I could not believe that the chasm between these and educated people was due to any great extent to their inherent nature. I saw that it was usually supposed to be by the educated, and I found myself unconsciously combating this view, and ascribing it almost exclusively to the difference in their education. In various debates I took that side, as between the relative claims of genius and circumstances. My companions all attributed everything to genius, and I would argue the potency of circumstances, usually being beaten, partly no doubt because the judges could not adequately weigh arguments for that side. But I remained unconvinced, and the influence of education and environmental conditions took an ever stronger hold of me. I have before me an old "oration" which I wrote in February, 1866, and delivered on April 11th before a certain literary club (the Concordia Lyceum) at its anniversary meeting, entitled: "The Importance of Intellectual Culture." I have recently read it for the first time since it was delivered. Though sophomoric in its style and backward in its ideas, it reflects this long-standing view of mine that culture, or "education," is everything. From that date on my ambition was to expand that idea into a book and give all my reasons *in extenso*. But I resolved to inhibit my inclinations until I had myself "finished my education," at least to the extent of earning one academic degree. This was to be at the end of the scholastic year of 1869, but, as already remarked, with the approach of that event my mind turned more and more in that direction, and I commenced planning my work as early as April of that year. In my diary for April 13, 1869, I find this entry: "I drew up a rough plan for the book I am going to write. I am bound to commence it in earnest on my next birthday. I have many ideas. Why hold on to them?" ("J'ai beaucoup de pensées. Pourquoi les garder?")

On many subsequent occasions, as I was progressing with the work, I would pause to draw up outlines, tables of contents, synopses, and classifications of heads. Sometimes, but not generally, I would date these. I kept all such things in an envelope labeled "Miscellaneous," to consult occasionally and then neglect or forget. In looking through the contents of this envelope [I find what I believe to be the pencilings made at that date (April 13, 1869).] They are made on two long, narrow slips of paper, written on both sides, the margins browned with age and unequal exposure to the light. They bear no date, but they have the most ancient look of anything in the envelope. They also bear marks of mental immaturity and "vaulting ambition," which reveal the crude and undigested state of my mind before I entered upon my prolonged task. Still, they have a certain historic value that is not possessed by any other documents, and they fully bear out the statements that I have just been making relative to the chief problem that was occupying my thought. For this reason, notwithstanding their crudity, and the fact that they were merely intended for my private guidance in beginning my work, I conclude to introduce them here without change.

PLAN OF THE GREAT PANACEA

PREFACE

INTRODUCTION.

Chap. 1. Man as distinguished from the lower animals.
Chap. 2. The influence of education upon a human being.
Chap. 3. Nature as seen by the educated and by the uneducated.

BOOK 2

INFLUENCE OF EDUCATION.

Chap. 1. Upon the mind.
" 2. " " body.
" 3. " Society generally.
" 4. " Government.
" 5. " Morals.
" 6. " Religion.
" 7. " Material progress.
" 8. " General "

[The "Books" are entered here in the same order and manner as on the notes, which seem to have been tinkered at various dates.]

BOOK 1

Universal Education.

Chap. 1. What constitutes a proper system of education.
" 2. How far the education of the masses should be carried.
" 3. Objections to universal intelligence.
" 4. Sources of opposition.
" 5. Real barriers to education.

BOOK —

Modes of Acquiring Knowledge.

Chap. 1. Letters.
" 2. Nature.
" 3. Reflection.

[The above is all on one side of one of the slips. The following occurs on the reverse side of the same slip.]

BOOK 3

The Field of Human Labor.

Chap. 1. All knowledge is experimental.
" 2. Man's right over the physical universe.
" 3. The classification of knowledge into scientific and historical.
" 4. Historical knowledge and what it embraces.
" 5. Scientific knowledge and what it embraces.
" 6. Relative importance of scientific and historical knowledge.

BOOK 4

The Sciences.

Chap. 1. The mathematics.
" 2. Physics.
" 3. Chemistry.
" 4. Natural History.
" 5. Astronomy.
" 6. Geology.
" 6. [intended for 7]. Mental philosophy.
" 7. [" " 8]. Moral "

BOOK 5

Historical Knowledge.

Chap. 1. General history of events.
" 2. Philosophy of history.
" 3. History of human thought.
" 4. Statistics and their uses.

[The following appears on one side of the other slip, evidently the second, but not numbered.]

BOOK 6

How shall the Reform be Brought about?

Chap. 1. Public opinion.
" 2. Compulsory system.
" 3. Voluntary system.

BOOK 7

The Evils under which Society Labors and their Cause.

Chap. 1. Effects of ignorance.
" 2. Oppression of government.
" 3. Tyranny of the church.

BOOK 8

DEMANDS OF THE CAUSE.

Chap. 1. More time.
" 2. Champions.
" 3. Cheap publications of standard works.
" 4. More independent writers.
" 5. Educated rulers.
" 6. Educational journals and tracts.
" 7. Missionaries.

BOOK —

VALUE OF THEORETICAL KNOWLEDGE TO INDUSTRY.

Chap. 1. Invention.
" 2. Agriculture.
" 3. Manufactures.
" 4. Commerce.
" 5. Communication.

[The following appears on the other side of this second slip.]

BOOK LAST.

RESULTS WHICH WILL FLOW FROM INCREASED INTELLIGENCE.

Chap. 1. Charity for human errors and tolerance of opinion.
" 2. Diminution of crime.
" 3. " " oppression.
" 4. Enlarged liberties.
" 4. [intended for 5]. Universal brotherhood.

On the same side of the slip last quoted from, but reading in the opposite direction, so as to require it to be reversed, are a number of sentences standing under the general head: "Desultory thoughts." I will not repeat them here because they are scarcely different from hundreds of others that I have jotted down from as far back as I can remember, but perhaps there are none earlier than these. I have a little book five inches long and three inches wide, containing 182 pages, which is nearly full of them. It bears date Jan. 12, 1870, but entries in it show that it covered the years 1870–1872. The thoughts recorded in it were revised at a later date and the chapter of *Dynamic Sociology* to which each applied was written over them. Most of them were embodied in the work as the chapters were reached, often without change in the phraseology. But this is by no means all. Such thoughts were always occurring to me (see *Pure Sociology*, pp. 442–443), and I formed the habit of calling them "inspirations" and recording them immediately, lest they escape. After 1872, this was done on separate slips of paper. As I grew more methodical I began to date them. I have two envelopes full of such slips, one of which is labeled "Inspirations used," and the other simply "Inspirations," implying that they have not yet been embodied in any work of mine. A great number of the former were incorporated in *Dynamic Sociology* in the manner described for those recorded in the little book. The "used" ones still far outnumber the others. There is only one on the memorandum we are now describing which it seems appropriate to quote here. It reads as follows:

"Education forms opinions, opinions beget volitions, volitions inspire actions." Here was the "hierarchy of means to ends" set forth two months before a word had been written of the book. But I find it drawn up on pages 84 and 85 of the little memorandum book much more in detail. Now as this must have been written there during the period 1870–1872, and as the "argument" at the end of Chapter VIII was not put into its final form, it is of interest to note how long it had been kept in mind. I will therefore copy this note literally here from the little book:

1. Happiness is the end of human existence.
2. Progress is that state by which happiness is increased.
3. Progress is attained by right actions.
4. Right actions result from correct opinions.
5. Correct opinions constitute knowledge.
6. All opinions are the result of circumstances.
7. Knowledge is the result of right circumstances.
8. Right circumstances constitute education.

Ergo, education is the immediate means of attaining the ultimate end of human life.

In this connection I should mention that there is another scrap of a memorandum written on the back of a letter form of the U. S. Bureau of Statistics, which indicates that I stopped in my official work in that Bureau to jot it down on the first piece of paper I saw. This deals with the same subject. It bears no date, and may have been earlier or later than the other memoranda. It is probably later. It is interesting in calling this hierarchy of means to ends an "argument," which is what I finally called it (Vol. II, p. 106). It is even more crude in statement than the others, but that very bluntness has a certain force. It is as follows:

1ST LOGICAL ARGUMENT

1. Happiness is the object of all human actions.
2. A state of progression is a state of increase of human happiness.
3. All progress is due to mental culture.
4. Hence increase of human happiness can only be secured by mental culture.

2D LOGICAL ARGUMENT

1. Circumstances create opinions.
2. Opinions " actions.
3. Actions depend upon circumstances.

3D LOGICAL ARGUMENT

1. Error causes all evil.
2. Education removes error.
3. " " evil.

4TH LOGICAL ARGUMENT

1. Men do what they *think* will be best.
2. They do not do what *is* best because they do not know what it is.
3. Therefore, to make them do what is best they must be taught what it is.

I am inclined to think that this memorandum was made before I commenced writing the book, or at least before I had advanced far with what I called the first real chapter of the book, which after much remodeling eventually became Chapter IX on *Utility*, in which the subject of human happiness is so fully discussed. That chapter was originally written in November, 1869. Certainly all this indicates what were the main ideas that occupied my mind at the time that I was planning the book, and that I had worked out a logical method upon which to proceed.

The subject of the book, so far as I can find, is not mentioned in my diary between the above named date (April 13th) and the appointed day. Although I did not receive my baccalaureate degree till June 30th, and my 28th birthday was June 18th, I carried out my resolution, and commenced to write the book on the latter day. To use my own words: "Selon une résolution depuis longtemps prise je fis mon début en écrivant un livre. Il sera consacré à la grande cause de l' éducation humaine et il doit exprimer mes idées, quoique tant soit peu nouvelles, sur ce sujet."

I proposed to write an introductory essay, merely to see what I could do in that line, and without any intention of publishing it or making it final. I wrote it on foolscap paper, and foolishly wrote on both sides. My idea was to rewrite it entirely at a much later date, after the rest of the book was written. This is what I nominally did, only I did not rewrite that, but wrote the real *Introduction* without even consulting it. I wrote a little on it nearly every day and finished it on October 1st. I do not know whether I ever read it over after having written it. It was filed away in an envelope and kept with the rest of the data relating to the book. As a preparation for writing this sketch I deemed it a duty to bring it out and give it a careful reading. This I have now done (November 17–18, 1910), and made notes upon it as I read. It consists of 117 pages of foolscap besides a few interpolated pages. No table of contents was originally prepared, but it contains three chapters, one entitled, *Nature:* the second, *Man:* and the third, *Mind:* followed by some *Concluding Suggestions*. After reading and annotating it I made the following general comment: "The chapter on *Mind*, is by far the best. That on *Nature* is full of error and false ideas. That on *Man* is mostly wrong, as derived from my readings in Agassiz. The style is fair and the diction excellent, but there are sophomoric flourishes. The essay as a whole is unfit for publication." In the notes, however, I have called attention to a considerable number of adumbrations of truths that have since come to form a part of my general philosophy. The chief defects were due to my ignorance of biology and anthropology. I had a distinct sense of my incompetency to deal with such subjects, and it was probably this that led me to make the manuscript incapable of publication.

On November 15, 1869, I made a beginning on what I called the book proper, and commenced writing the first chapter. That day I bought half a ream of cheap notepaper costing one dollar the ream, and the whole book was written on that kind of paper, new supplies being purchased when the old ones were exhausted. The paper is very thin, and in revising the chapters years later thicker paper was used, so that it is easy to see how much of the original was retained and how much rejected. This first chapter I think I called *Utility*, but as the first page no longer exists, I am not certain as to that. It is what is now Chapter IX, still called *Utility*. No table of contents was drawn up, but the order in which the chapters were written indicates the proposed treatment. This chapter was finished on November 30, 1869, and the statement is made under that date that it aims to demonstrate that happiness is the object of human actions. My ignorance with regard to it in general is due to the fact that very little of the original remains in Chapter IX after revision. This will be explained at a later stage.

The whole of this chapter was written at my office in the Bureau of Statistics. From June 1, 1869, to November 30, 1875, all the departments of the government closed at 3 P.M., and it was my habit, after finishing my official day's work, and after all the others had gone, to remain an hour, sometimes two hours, and write on my book.

On December 2, 1869, I commenced writing the second chapter, which was called *Progress*. It corresponds to Chapter X, with the same title. It was finished on February 2, 1870. It was chiefly written at the office, but, as I wrote Sundays, a portion must have been written at home. On Sunday, December 19th, for example, I wrote seventeen pages without rising. Whether I brought the manuscript home on Saturdays for the purpose, or whether I merely noted the page number and, knowing what was last written, went on with it, I cannot tell. The several subheads are not generally mentioned, and most entries simply state the number of pages written that day, but on January 16, 1870, "I began a discussion of the origin and influence of religion." I was appointed to deliver a lecture at the Sunday Lyceum on February 20, 1870, and I concluded to use the part of this chapter relating to religion. I remodeled it considerably, adding several pages. It was delivered at the time appointed, and was very well received by the members. One of them borrowed it to read by himself.

The third chapter was the one on *Knowledge*, which now forms Chapter XIII. This shows that I was far from having perfected the logical arrangement of subjects. This chapter was begun on February 3, and finished on March 30, 1870. It was written at both ends of the line, and on many days I would write a number of pages at the office and more at home in the evening. How I did this I do not know, but presume I brought pages home to go on from, and took the last one written at home to the office the next morning. Very few of these old original pages remain. In the final manuscript it was mostly rewritten. I numbered them not by chapters, but for the whole book. The first chapter contained only fifty-one pages. The second was much longer and ended on page

234. The third was also relatively long, and carried the work to page 421. On April 1st, I commenced the fourth chapter which I called *Circumstances*. This finally took the form of the present Chapter VIII, and the name *Adaptation*. It was completed on May 1st. This was also written in the two places, but I divided up the subjects and wrote on one subject at the office and on another at the house. I do not know what the subjects were, and I suppose I left the pages written at the house unnumbered till all was done and then numbered them to follow the first part. So little is left of these old pages that nothing can be learned on these points. On April 28th the 500th page had been reached, but 28 additional pages had been written at the house. What were pages 477, 478, and 507–510 still stand with numerous erasures and interlineations.

On May 2, 1870, I commenced writing the chapter on *Opinions*, which was called Chapter V, and is now Chapter XII, but the word is now used in the singular. This chapter was written almost entirely at the office, and was finished on May 29th, but on May 8th I began to write the sixth chapter, viz., the one on *Actions*, at the house, and I carried both chapters along in this way, usually writing some on both chapters every day. Sometimes I would get to my office half an hour before 9 and write awhile before business began. Some mornings I would get up early and write an hour before breakfast. For some reason I stopped writing at the office about May 21st, and wrote only at home after that date. Sundays I wrote about all day. On June 12th I wrote twenty-three pages. On June 16th I got up at five and wrote ten pages before breakfast. These entries show how great my zeal was in the work. On June 18th occurs this entry: "Wrote 7 pages and finished the chapter on Actions. This completes the first volume which I began just one year ago to-day."

We are now in condition to draw up the scheme of the first volume. It was to consist of an introduction and six chapters as follows:

Introduction. Written June 18 to Oct. 1, 1869.
Chapter I.—Utility. Written Nov. 15–30, 1869.
" II.—Progress. Written Dec. 2, 1869, to Feb. 2, 1870.
" III.—Knowledge. Written Feb. 3 to March 30, 1870.
" IV.—Circumstances. Written April 1 to May 1, 1870.
" V.—Opinions. Written May 2–29, 1870.
" VI.—Actions. Written May 8 to June 18, 1870.

I wrote nothing more during the year 1870, being well worn out with this work added to my law course and the work I was doing on the *Iconoclast* (see Nos. 7–70, Vol. I, pp. 42–244).

As we have seen, the section that I wrote on the origin and influence of religion was made to form part of the chapter on *Progress*. As time went on I reflected on the subject and finally decided to write something on government corresponding to what I had written on religion. But for some reason I did not think of having it form a part of the chapter on *Progress*, and contemplated it as a distinct chapter. I proposed to begin it on the first day of 1871, and accordingly I find this entry under that date, which happened to fall on Sunday: "Wrote three pages preparatory to writing a treatise on government the same as I did on religion." I wrote more or less nearly every day and finished it on February 23d. It was all written at the house. I wrote it on the same kind of paper as I had always used, but do not say how many pages it contained. It must have been a long essay, and have contained much more than the amount devoted to that subject in the present Chapter X (forty printed pages; Vol. II, pp. 212–252). In none of the several drafts of the contents of the book that I find among the miscellaneous papers is *Government* ever given as the title of a chapter, and I probably soon concluded to include this treatise in the chapter on *Progress*, as I had that on religion. In the final form the treatment of government precedes that of religion. In looking through the manuscript of Chapter X, I find a considerable number of the original pages retained with corrections. In the upper right-hand corner occur letters of the alphabet which were given them in lieu of numbers. Though many are missing, it is clear that the English alphabet was first exhausted, and then the Greek alphabet was used as far as it would go, and finally the German script was used. The last page retained is numbered with the German *ŭ*. The original manuscript on government therefore seems to have consisted of about seventy-five folios. This way of numbering the pages seems to imply that I intended to interpolate this manuscript in some manner, and not to have it follow the chapter on *Actions*. But it was intended to form part of Vol. I, for on February 23, 1871, this entry occurs: "I wrote the whole evening in my book and finished my chapter on Government. My first volume is now done."

I was now prepared to enter upon what I regarded as the real subject of the work, viz., Education. The six (or seven) chapters constituting the first volume were only preparatory to this, that is, they constituted the argument for the justification of a treatise on education. But again I waited for an appropriate moment to begin. The *Iconoclast* and my law studies were still going on, and for the latter I wrote an elaborate essay on "Title to the Soil," which drew a $20 prize. On June 12th I took my degree of bachelor of law, and on the 15th was admitted to the bar of the Supreme Court of the District of Columbia. My natal day (June 18th), on which the book had been begun two years before, seemed to be a suitable date for beginning the second volume. It was in fact begun on that day, when I commenced writing the long chapter on *Education*, which was destined to occupy me for more than two years, and then to be ultimately cast aside as unworthy of publication. I wrote on many days in August, and then took a long rest, including a "big hunt," and did no more till October 22d. By that time the *Iconoclast* had suspended and I was relieved of the onerous duty of editing it and contributing most of its matter. On October 22d I read over what I had written and resumed work. On the 24th I record that I "finished the subject of 'What constitutes education.'" It was in that section and at that time that I framed my definition of education, though not in the exact words of the final definition. This section ends on page 110 of the manuscript. I did not seem to have much zeal for this work during the fall of 1871, as I wrote only occasionally of an evening. I was taking a course in practical chemistry and had to go out on the hill and work in the laboratory in the evening. This work was for the master's degree that I was seeking.

I was dissatisfied with this inability to work nights on the book, and on January 6, 1872, I resumed my habit of remaining after office hours to write. But instead of taking the chapter on *Education* to the office and continuing it there, I left it at home to write on it when I could, and opened a new chapter at the office, to be written independently of the other. This was the chapter on *Society*, which was then intended to constitute the second chapter of Vol. II, and to follow the one on education. What is left of it is now embodied in Chapter VII, which concludes Vol. I. I wrote on both these chapters as I could till spring. On April 15th I read over what I had written at the office, and on the 21st I "looked rapidly over most of my chapter on education."

By May 1st I had one hundred pages written on the *Society* chapter. This method of work was continued until July 11th, when I stopped writing and did no more in 1872.

On January 4 and 5, 1873, inspired somewhat by a visit during the preceding holidays from Dr. Wm. B. Owen of Lafayette College, to whom I read large parts of my manuscript, I resumed work in earnest upon it. I was taking a course in practical anatomy (dissection) which consumed my evenings, but I wrote from three to four or even five nearly every day at the office on society and most of my Sundays at the house on education. I record that on February 3d, I "commenced the subject of Modes of Acquisition" (see Vol. I, p. 524). That phrase is now coming into current use. The spring and summer of 1873 were largely occupied with building operations, which continually interrupted my literary work. I had also entered upon my scientific pursuits, especially my botanical studies (see No. 119, Vol. II, p. 449), and was generally engrossed in such outside matters. Still, I had occasional spurts of enthusiasm, and wrote considerable whenever I could, especially on the education chapter. On August 17th, I finished the section entitled: "How shall education be conferred?" This began on page 201 of the manuscript and was commenced in April, 1872. It ends on page 500 and covers an immense field. On August 19th the section entitled, "What knowledge shall be conferred?" was begun. This is the last section of that chapter, and as I neared the end I acquired renewed interest and wrote rapidly nearly every day, completing it on September 26th. I then read it all over and on the 30th it was done.

This chapter, as I have stated, was excluded bodily from the final work, the reasons for which will be explained later. It was laid aside and still remains exactly as it issued from my pen on the last named date. It lies before me now intact with its 650 folios written in a plain, legible hand, as easy to read as print. It was written, as we have seen, from June 18, 1871, to September 26, 1873, or during a period of two years, three months, and one week. I will interrupt the strictly chronological record here given in so far as to complete the history of this excluded chapter, which is very brief. On March 23, 1880, I commenced reading this manuscript and finished the same on the 28th. I noted the sections on separate slips and made a few comments at certain points. On the last named date I say: "Finished reading my old chapter on Education. I find it far superior to my most sanguine expectations. It is too long to go in my book and too systematic to break up. So I shall have to use it in some other way if at all." I have now (November 18–24, 1910) read it again and with especial care. I have greatly extended the notes and comments of 1880. The following is the general remark appended to those notes on the completion of the review: "Written with great vigor and generally in good style. Contains many things nowhere else written by me, including some very fine passages and splendid illustrations that I could not now write, having forgotten the details. It also contains many hints at principles since developed by me. It might be published after careful editing. It needs to be made much more impersonal."

At neither of these dates was any systematic table of contents of the chapter drawn up. I have now (Dec. 1, 1910) done this, and it is as follows:

The chapter on *Society* had long been in abeyance, but having now finished the one on *Education*, I resumed work on the other the second day of October, 1873, "beginning on the 192d page." Looking through the manuscript of Chapter VII, I can detect these old original pages whenever they remain. The page numbers were written over the top in the middle. These numbers are now crossed off and the new numbers written in the upper right-hand corner. Of these old pages those numbered 181 and 196 remain, but none between these. The old page 181 falls on page 523 of Vol. I as printed, and 196 on page 527. This shows exactly where I was then writing, viz., on Modes of Acquisition and their classification, but this was all rewritten and the old matter rejected. The next day (October 3d) I said: "Wrote slowly. My subject is now taking definite shape and I shall have no trouble in going on." And on I went, writing a large amount nearly every evening. On the 27th I say, "Finished Producers and took up Non-producers," and on November 2d, "Finished the subject of Accessories to Production." The next day I "commenced about the parasitic class." On the 11th I "finished the Preservative and commenced the Reproductive Forces." On the 30th I "finished the subject of Marriage and began the Genesis of Modesty." This day's work brought me to page 492 of the old manuscript, which is renumbered 504, and ends near the top of page 639 of Vol. I of the printed book. I mention this because there was a long interruption of my work on the book at this point. It was not resumed till March 1, 1874. The interruption was mainly due to building, by which the family were almost compelled to live in the kitchen for a long time. When the builders finally got through and left there were many minor things that I was obliged to do myself.

On the last named date (March 1, 1874) I resumed work where I had left off three months before, and went on about as usual. On March 4th I "finished the Genesis of Modesty." On the 6th I took up the next topic saying: "Was a long time getting to writing. Had to look back and get my bearings and make a beginning on the new subject of the relations of the sexes." On the 17th I "finished the Reproductive Forces," and on the 20th I "commenced the new division of the Non-essential Forces." On April 16th, I "finished the Esthetic Forces," and on the 17th "made a two-page commencement on the Moral Forces." On June 18th occurs this entry: "It being my (33d) birthday I determined to complete the outline of my book which was commenced five years ago to-day. I therefore staid at home and finished it by writing about a dozen pages. The entire work consists now of about 2500 pages of commercial note paper, the two volumes being nearly equal. . . . I consider this only the outline and intend to give it a thorough revision after about two years' reading and maturing the subject. Then I propose to publish it, and if it fails, let it fail."

There the matter rested till August 13, 1874. I had been thinking about writing something on the application of the principles I had laid down, and on that day I wrote: "I have concluded to try to write a supplementary chapter on the improvement of society. I made a beginning, writing one page." I wrote it at my office in the Bureau of Statistics, doing a little on it nearly every day for more than a month. September 15th is the last record of work done, and there it ended, but of course in a wholly unfinished state. The manuscript contains seventy-eight pages of the same kind as all the rest. No title was given to it and there are no headings or subdivisions. It is simply an introduction to the subject. The words: "Concluding Chapter

(XV) Meliorism," are now written over the top of the first page in pencil, but this has been done recently. I had never heard the word "meliorism" when I wrote it. But later, as will be seen, I did propose to call this chapter *Melioration*. It was entirely ignored in the final make-up of the book. I have read the manuscript over with some care since I commenced this sketch (November 19–20, 1910), and made a few notes. It is fairly well written and contains hints at a number of modern principles, but I do not now see what use can ever be made of it.

Conformably to my resolution, I stopped writing entirely and devoted myself to extensive reading and to scientific studies that I considered necessary to prepare me to revise or rewrite the book. Not a word was written during the entire year 1875, but it was in that year that I made my five-months campaign in the Far West and the large collection of plants. Much of the winter was spent in preparation for this, and the autumn was devoted to working up the collection that I made and in other botanical work. But I also did much reading that year, including Bacon's *Instauratio Magna* (in Latin), Whateley's *Logic*, Spencer's *First Principles*, *Principles of Biology*, and *Principles of Psychology*, Lyell's *Principles of Geology*, and Draper's *Conflict*. I also commenced reading Comte's *Positive Philosophy*. This last, the six volumes in French, was finished on March 26, 1876, and in April I commenced reading Haeckel's works (see No. 85, Vol. II, p. 64). All this reading and scientific work decided me to lay a scientific foundation for my book, and also to write a historical part. I had begun to see that what I was writing was *sociology*, and that I should try to do something original in that science. The sociology of Comte was not what I aimed at, and Spencer's sociology was not yet published, although his *Study of Sociology* had been running through the *Popular Science Monthly* since that journal was started in May, 1872, and I had read all the articles. But Spencer's sociology was even less in harmony with my ideas than Comte's. I was an apostle of human progress, and I believed that this could be greatly accelerated by society itself. I therefore wanted a progressive sociology, and it seemed to me that that was the science naturally adapted to its furtherance. But I did not exactly like the phrase "progressive sociology," and I continued long to seek for a better one. I saw that the word "dynamic" was generally used in the sense of change or movement, and it seemed appropriate to any science that deals with a changing state. Comte's long treatment of Social Dynamics (*Dynamique sociale*) interested me, and I was tempted to use it as the title to my book. But I also wanted to call the book Sociology, and how to bring about the compromise was the question. Of course I could say *Dynamic Sociology*, but I dreaded innovation, and that phrase, so far as I knew, had never been used. It does not occur, I think, in the whole of Comte's treatment of Social Dynamics, either in his fifty-first lecture, so entitled, in Vol. IV of the *Positive Philosophy*, or in Vols. V and VI, which are the prolonged expansion of that lecture. Under the date of April 8, 1876, I find this entry in my diary: "I commenced to prepare at the office a sort of prospectus of my book." In the envelope of miscellaneous matters relating to *Dynamic Sociology*, I find this "prospectus" with the date (April 8, 1876) written in the upper left-hand corner. It is on one side of a half sheet of foolscap. As it is the very earliest date at which either of the above-mentioned phrases appears, it has a special historical value. It gives the proposed contents of Vol. I only, and on the right is an estimate of the number of pages to be devoted to each topic, all of which together foot up 550 pages. It is written in pencil, very light, but legible. The following is a literal copy of this document:

April 8/76

SOCIAL DYNAMICS, OR DYNAMIC SOCIOLOGY.

VOL. I.—THE METHOD.

Introduction	. . . .	pp. 50

PART I.—*Historical Division.*

Chapter	I.—History of Sociology	50
"	II.—Comte and Spencer	50
"	III.—Present state of the science . .	50

PART II.—*Data of Sociology.*

Chapter	I.—Nature	50
"	II.—Man	50
"	III.—Mind	50

PART IV [*Intended for* III].—*Progress.*

The second volume, had I drawn it up, would probably have consisted of the two great chapters on *Education* and *Society*. Possibly I might have added the unfinished one on the improvement of society. It will be seen that Parts I and II were unwritten, but their introduction here shows that I had already vaguely in my mind the plan of the first six chapters of the work as it finally appeared. I said that I would copy this prospectus literally, but there is one important respect in which I have not done so. This consists in the fact that there are two lines drawn diagonally across the sheet, crossing in the middle, and thus cancelling the whole proceeding. In short, after drawing it up I entirely suppressed it, as after all not meeting my views. The wonder is that I did not destroy it altogether. And yet, how fortunate that I did not! That will be clearer with the next step. It will be remembered that I only said that I "commenced" preparing the prospectus on April 8th. There is no record of its completion, but I find another paper exactly similar to this in outward appearance, and bearing every evidence of having been done in the same way. This is similarly dated in the upper left-hand corner only two days later, and is as follows:

April 10/76

VOL. I—DOCTRINE.

		pp.
Introduction		50
	PART I.—*Historical.*	
Chapter	I.—History of Sociology	25
"	II.—Comte	50
"	III.—Spencer	50
"	IV.—Present State of the science	25
	PART II.—*Data.*	
Chapter	I.—Nature = Cosmology	50
"	II.—Life = Biology	50
"	III.—Man = Anthropology	50
"	IV.—Mind = Psychology	50
"	V.—Society = Sociology	200
		600

VOL. II.—METHOD.

Chapter	I.—Utility	50
"	II.—Progress	100
"	III.—Circumstances	50
"	IV.—Knowledge	50
"	V.—Opinions	50
"	VI.—Actions	100
"	VII.—Education	200
		600

The first fact that strikes the eye is the absence of a title. Had I destroyed the other draft, it would have been about a year later that the phrase *Dynamic Sociology* would have occurred in the record. And here is the place to remark that I finally adopted that title without knowing that it had been used before. By this I do not mean to claim credit for it, because it was used by Comte before I was born, only I was not aware of that. I did not read the *Politique Positive*, in which it figures so extensively, till 1894, when I first visited the Domicile (10 rue Monsieur le Prince) and purchased it in the same room in which Comte wrote it. It was not until I had read that work and discovered that I had been so long anticipated by Comte, that I had the curiosity to search carefully through the *Philosophie Positive* to see whether perchance it might occur also in that work. I succeeded in discovering two passages in Vol. IV in which Comte used the phrase. These are on pages 263 and 412 of the edition of 1869, which is uniform in pagination with previous, but not (unfortunately) with subsequent editions. There may be other cases, but these are all I have thus far found. To the question why I did not discover these uses of such an important combination of words when I read the *Philosophie Positive*, the answer is that when I read that volume in January, 1876, the question of a title was not yet seriously occupying me, and I might easily have overlooked the importance of these words. Again, my habit was to have French works read to me by Mrs. Ward, and in simply listening to another it would be easier to miss such a combination than if I had seen it myself on the page. Add to this that the first passage in which Comte used it is in his forty-eighth lecture, on the positive method, and the second is in his fiftieth lecture, on social statics. It was not until I read the fifty-first lecture, on social dynamics, that my attention was strongly drawn to the word *dynamic*, as a substitute for my word *progressive*, and I do not find this phrase in that lecture. After reading that lecture I was inclined to call my book *Social Dynamics*, and it will be noticed that this title occurs first in the cancelled prospectus of April 8th. But there was a serious objection to that title. I greatly desired to have the word *sociology* appear in the title. Comte first used it ("coined" it) on page 185 of that same volume, and I fell in love with it. The problem was to combine the word *dynamic* with the word *sociology*, and what more natural than simply to put them together? Comte did it in 1839, and I did it in 1876, in both cases as a simple logical process of the mind. But I did it haltingly. I feared innovation. If I had found it in Comte I should certainly have cited volume and page, and thus escaped responsibility. As it was, through dislike of neoterism, I still at that date leaned in favor of the name *Social Dynamics*, which Comte had sanctioned.

The other differences between the two prospectuses are very apparent. I must have done some heavy thinking in those two days. For the first time the great chapter on *Society*, which had always followed the one on *Education*, was removed from that illogical position and placed in its proper relation to the other great fields of nature, after the chapter on *Mind.* Moreover all these great departments of nature were now recognized as the subjects of so many sciences, and Cosmology, Biology, Anthropology, Psychology, and Sociology emerged for the first time in my scheme. The six chapters of the last part of Vol. I of the earlier prospectus were relegated to the second volume, as dealing with the method. In the first prospectus the chapter on *Opinions*, which was then written, was inadvertently omitted, and a chapter on *Natural vs. Artificial Progress* was introduced, which was suppressed in the second prospectus. Here also a chapter on *Life* (*Biology*) appears for the first time. In fact, this prospectus is a near approach to the final form of the scheme.

All of Vol. I, as thus planned, with the exception of the long chapter on *Sociology*, was as yet unwritten, and I now began to feel qualified to undertake to write it. On May 24, 1876, occurs this entry: "Looking over the prospectus of my book I concluded that I could profitably write out the Introduction here at the office and accordingly I made a beginning on it of 4 pages (official note paper)." This shows that the prospectus, made at my office, was still there, and I was staying after hours to work on my book. The words in parenthesis need explaining. On glancing at the manuscript I see that they are true. It is written on official note paper. The Department allowed us to draw this for private use; I think, in fact, we were all furnished with a certain allowance. Some used it, but I never did, not considering it in good taste, and a considerable amount had accumulated in the drawers of my desk. It was getting soiled, and unfit for use, and I decided to cut the sheets in two and use it for manuscript. Every other page has the official heading: "Treasury Department, Bureau of Statistics. ——, 187 ." Of course I wrote on the blank side of these sheets. I stayed to write after office hours several times during May, and wrote 24 of those folios. I then ceased for some reason, to me now unknown, and did not resume till Aug. 2d. Then I wrote nearly every day and finished the *Introduction* on Aug. 31st. No more was done till Nov. 13th, when I interpolated the discussion of the "paradoxes of nature" (Vol. I, pp. 45–53).

I had now not only read Comte's *Positive Philosophy*, but had placed it within easy reach by posting it into my *index rerum* (see No. 487, sketch) which had become my main dependence, and I was ready to write the sketch of it to form the first chapter of the book according to the scheme drawn up in April. On Dec. 13, 1876, I began this work, still writing at my office, as before. By the 26th I had written 39 folios, and I found it impossible to proceed farther away from Comte's volumes, which were at my house and could not well be taken to the Department. I therefore took the manuscript home and wrote the rest of the chapter there. I did not resume writing, however, till Jan. 7, 1877, and then I wrote rapidly and finished the chapter on the 29th.

On Feb. 15, 1877, I find this entry: "I commenced writing a little additional to my Introduction, chiefly in support of the right of society to adopt progressive measures." This discussion begins on page 61 and ends on page 64 of Vol. I. On March 2d and 3d I interpolated another discussion into the *Introduction*, viz., that of negative and positive social progress. It begins on page 55 and ends on page 61 of Vol. I. These interpolations were made by using the letters of the alphabet affixed to the last preceding page. In this case it went exactly from *a* to *z*. The first of these interpolations was made at the house and the second at the office.

On March 12, 1877, I commenced writing my critique of Herbert Spencer's works so far as read, which was to form Chapter II. It was to be confined to the *Synthetic Philosophy*, but I drew the *Social Statics* from the library of the Treasury Department on the 23d and looked it through. I finished reviewing the *First Principles* on the 25th, the *Principles of Biology* about the 31st, and the *Principles of Psychology* on April 11th. This was all that I had been able to obtain, although the first volume of the *Principles of Sociology* appeared in England in 1876, and I had written to the Appletons for it without receiving any response. This chapter was written at the house. After finishing it I almost immediately wrote my article on "Cosmic and Organic Evolution" (see

No. 89, Vol. II, p. 148), which grew out of it and is really included in it.

There is another prospectus of the book dated April 2, 1877, although there is no record of preparing it on that day or at any other time. I need not introduce it here in full because it so closely resembles the one dated April 10, 1876, which I have introduced (supra, p. 175), but I will state the particulars in which it differs from that. Over the top is written: "Prospectus of Dynamic Sociology." The word *Doctrine* does not occur after "Volume I." Opposite Chapter II are the words: "Auguste Comte" instead of simply "Comte," and after Chap. III, "Herbert Spencer" instead of simply "Spencer." In Part II the chapters are given exactly the same as in the earlier prospectus, but Chapters III and IV are marked to be transposed, thus placing Mind (Psychology) before Man (Anthropology), which order was subsequently followed. Vol. II is made to consist of two parts, of which Part I, called "Doctrine," consists of the same six chapters as before, and Part II, called "Method," contains the chapter on *Education* only as Chap. VII. To this prospectus are attached three "references" in the form of footnotes, called respectively: (1) "Outline executed;" (2) "Unwritten;" and (3) "Outline very imperfectly sketched." The several chapters are followed by these numbers, as follows: (1) Introduction; Vol. I, Chapters II, III, and V. Vol. II, Chapters I–VII, i. e., the whole of it. (2) Vol. I, Chapters I and IV of Part I, and Chapter II of Part II. (3) Includes Chapters I, III, and IV of

Part II. These are all easily explained except the last. What I meant by "Outline very imperfectly sketched" is the question. As I had not yet written a word on what are now Chapters III, V, and VI, which are the ones so designated, I am obliged to infer that I had reference to the treatment of the subjects "Nature," "Man," "Mind," in the old original "Introduction" (see supra, pp. 157, 158). If so, they certainly were "very imperfectly sketched." But it shows that from the very outset I had had these three great fields of phenomena in my mind as the ones underlying my entire subject. The omission of "Life" or "Biology" from that original paper was due simply to the fact that I included it under "Nature." The number of pages assigned to each chapter was the same in this prospectus as in the earlier one, but either at that or a later date I had been counting not only the pages of my already written manuscript, but the number of words on a folio and the number on an average printed octavo page, and I find written at the bottom of the first sheet of the prospectus (the volumes are on separate sheets) the words: "Count 3 pages of *note* to one *print*." On Dec. 30, when Prof. Wm. B. Owen was my guest during the Christmas holidays, and I had read him, at his desire, large portions of the book, it is recorded that "we counted up all the pages I have written, and by counting the words of MS. and of a book (Spencer) we made a calculation showing that I have now written enough with [within] about 200 printed pages to make two 600 page volumes."

It may have been at this time that I appended the above-mentioned note to the prospectus.

On May 3, 1877, I commenced at my office to write up the subject of the genesis of feeling, which I finished on July 23d. Most of it was written in July. That essay now forms the first part of Chap. IX, and underwent only slight change in the final revision. By this time I had finished reading Spencer's *Principles of Sociology*, Vol. I, and on July 25th I commenced reviewing that as a simple continuation of what I had written on the earlier volumes. It was finished on Aug. 7th.

Eight months elapsed before I again put pen to paper on the *Dynamic Sociology*, but I had not been idle. I was simply qualifying myself to begin the final draft of the work, most of all that I had thus far written being looked upon in the light of a rough draft or preliminary, tentative outline sketch. On April 10, 1878, just two years after drawing up the first complete prospectus, I set in in earnest to write the book itself. But the new *Introduction* and the two chapters on *Comte* and *Spencer* were sufficiently modern to stand as integral parts of the work, and I began with what I still called "the chapter on Nature." On the 25th "I got out my oldest manuscripts and commenced reading them over." To this statement I add: "They are wholly obsolete." On the 26th "I finished reading my essay on 'Nature.'" And I added: "I can use very little of it." In fact I used none of it, and the manuscript is wholly new. On May 7th I "finished my chapter on the Cosmology." The final manuscript does not show what title was then given to this chapter, but it probably conformed to the prospectus, i. e., "Nature.—Cosmology." After resting for a week, on May 14th I "resumed my writing." And I add: "I am writing a supplement to my last chapter, on the properties of matter, introductory to the chapter on biology." On the 16th occurs this entry: "Wrote 6 pages, but 2 of them were wasted. I argued myself round on the opposite side from what I first tried to establish." Truly books are like laws and sausages. Our respect for them diminishes in proportion as we know how they are made! This supplementary discussion begins on page 285 of Vol. I. It was finished, and with it the chapter on *Cosmology*, on May 20, 1878.

As above intimated, I considered this chapter a natural antecedent to the one on *Biology*, being already firmly imbued with the idea of the complete continuity of all the great departments of nature in the order of the Comtean hierarchy. On May 22d, I began writing the chapter on *Biology*. I wrote steadily and rapidly nearly every evening, and finished it on June 27th.

Notwithstanding the transposition indicated in the prospectus of April 2, 1877, by which the *Psychology* should precede the *Anthropology*, so firmly had the old order of the original *Introduction* taken hold of me that I adhered to it now, and wrote the *Anthropology* before the *Psychology*. This chapter was begun on July 10, 1878, put through with great rapidity, and finished on the

24th. On the 26th and 27th I wrote the preliminary portion of the large chapter on *Society*. It seems to have included the matter on pages 450 to 456 of Vol. I, and was suggested by the treatment of man just closed. That of itself should have shown me the proper sequence of the chapters.

On July 27th I began to write the chapter on *Mind*. This was still more rapidly written, not a day being missed till it was completed on August 12th. The record of that day runs: "Resumed writing and at just 9 o'clock I finished my chapter on Mind. This completes the work and makes quite an era in my life."

The work was, indeed, then outlined, but the revision proved an immense task. It was begun on Sept. 12, 1878. The first chapter to be revised was the one on *Cosmology*. This and the three succeeding chapters were the last to be written, all in 1878, and were presumably the best-written of the book. These four chapters constituted a complete philosophy of evolution up to and including the human race. It occurred to me that, whether I ever published the book or not, I might possibly publish these chapters as a series of articles. I therefore decided to send the first of these chapters to the *Popular Science Monthly*. I revised it thoroughly from Sept. 14th to 23d, and on the last named date I sent it to Dr. E. L. Youmans with an explanatory letter.

On Oct. 26, 1878, I commenced the systematic revision of the whole book, beginning with the *Introduction*, which, having been written in 1876, was in fairly good shape and occupied me only till the 31st. On Nov. 4th and 5th I interpolated something more into the *Introduction*, and more still on the 10th, the exact nature of which I am now unable to determine. Nov. 11th to 15th I revised the chapter on *Comte*, and the 16th to 21st the one on *Spencer*. The chapter on *Life* was revised Nov. 22d to 25th; that on *Mind*, Nov. 25th to 26th; that on *Man*, Nov. 27th. On the day last mentioned occurs this entry: "Commenced looking into the chapter on Society written 5 years ago. I found it very imperfect and it will have to be practically rewritten." Here begins the practical rewriting of all the older portions of the book. I first made a preliminary revision without rewriting much. This was finished on Dec. 5th. Then I went back and commenced the final revision, rewriting wherever it was required. Much additional matter was introduced. The footnote on page 497 relative to the average production of wealth per capita per diem was compiled at the office on Dec. 13th. The chapter was finished on Dec. 22d, but on Jan. 12, 1879, I made another "interpolation . . . answering the pretended scientific argument against woman's rights." This constitutes the entire section beginning on page 657, entitled: *Attitude of Science toward the Equalization of Woman's Condition.** That chapter was then completed. Looking through

* In this section the gynæcocentric theory is first clearly stated. It therefore dates back to 1879, and not 1888, as I erroneously said in *Pure Sociology*, p. 297.

the manuscript I find that, as nearly as I can judge without a count, about half of the original pages remain, but they are much altered. A large number of the new folios are in Mrs. Ward's hand writing. The way this occurred was as follows: I would revise the old folios, erasing and interlining until I got them into the shape I wanted them, and then, when they looked too bad, or seemed likely to get misprinted, I would turn them over to Mrs. Ward to copy, which she did very neatly. This was our method with all the old manuscripts.

All my attempts to get any part of the book published in the magazines failed. Dr. Youmans returned the chapter on *Cosmology* with an appreciative letter, but saying that it was much too long for his use and too speculative for the *Popular Science Monthly*. He advised me to send it to the *Journal of Speculative Philosophy*, which I did, but of course without success. He could not have known, and I certainly did not know, what Dr. Harris meant by "philosophy." He was a thorough Hegelian, and Hegel's universe was exactly the other end up from mine.

The last day of the year 1878 I undertook to "take stock," as it were, on the book, and to work up "a sort of chronological record of work on my Dyn. Soc." I worked on that much of New Year's Day, 1879, bringing the history down to date. I find these memoranda among my effects, and the record is very accurate. I have made constant use of it in the present sketch.

From Jan. 14 to 21, 1879, I gave the *Introduction* another searching revision, and the last four of those days I introduced into it for the first time the doctrine of "attractive legislation." The folios were numbered from 129*a* to 129*s*, and the phrase first occurs on folio 129*g*, which falls on page 40 of Vol. I. I placed these words in quotation marks in my manuscript and they are so printed, but there was no good reason for this, because they had never been penned before. They should have been printed in italics. On Jan. 24, 1879, "I fixed up from my MSS. an article on Science and the Woman Question," which I took to Mrs. Lockwood (Belva A.) on the 27th, to see if she could find a publisher for it. She advised me to see Mrs. H. C. Spencer, who was associated with the journal "Woman's Words." This I did the next day, and the latter took the manuscript, saying that if she used it she would have it copied for me. She kept it a long time without making any use of it, and I had considerable trouble in getting it back. I remember calling on Susan B. Anthony at the Ebbitt House in relation to it, and trying to interest her in the deeper aspects of the woman question, and that she treated me rather rudely.

On Jan. 25, 1879, I conceived the idea of dividing the *Introduction* up into several articles and trying to get them published separately. I carved out three such, and wrote preliminary matter for each to make them independent. One of these was sent to the *North American Review* on Feb. 3.

Major Powell allowed me to use his name in connection with it, but of course it was not accepted. One article that I took from the chapter on *Cosmology* got published. That was the one on the "Evolution of the Chemical Elements" (see No. **109**, Vol. II, p. 294). With this exception all my efforts at separate publication of parts of the book were unsuccessful.

It was not till Jan. 17, 1879, that I told Major Powell that I had written a book. He was greatly interested and offered to help me in any way he could about publishing it. Vol. I was now ready for the press, and I knew that if I could find a publisher I could have Vol. II ready before it could be reached. The Globe Printing Office in Washington had recently published a book about which much was being said, it being the first book published by a private firm in Washington. I thought I would at least inquire about their equipment for publishing, and on March 15th I went to see Mr. Rives, head of the firm. He said he could not undertake anything at once, but in a month would look into it. On the 29th he wrote me for particulars. Down to that time I had nothing to go by but the several prospectuses described, all written in pencil and forming no part of the manuscript. They were merely memoranda for my own use. On March 24, 1879, I drew up duplicate title page and contents in ink and sent them to Mr. Rives. These are preserved and are of the utmost value in this historical sketch. I give them here in full.

An Inquiry

into the

Conditions to the Establishment

of the Science of

Dynamic Sociology

Both Pure and Applied.

By

Lester F. Ward, A.M.

Vol. I.

(*Imprint.*)

DYNAMIC SOCIOLOGY.

By Lester F. Ward.

TABLE OF CONTENTS.

VOLUME I.

Besides an exact duplicate of these sheets there are two practically identical tables of contents of Vol. I, differing from these in several particulars. Instead of "Introduction," we find "Preliminary Outline"; instead of "Part I.—Historical," there is "Part I.—Historical Notices." Instead of "Part II.—The Data," there is "Part II.—Coordination of the Sciences." None of these sheets were dated, but there seems little doubt that they are the ones referred to under the last named date. These constitute another advance toward the final form, but the division of both volumes into parts, the arrangement, and to some extent the titles, of the chapters in Part I of Vol. II, and especially the introduction of a chapter XV on *Melioration* constitute important differences. On April 12, Mr. Rives declined to undertake the publication of so large a work. There is a prospectus of Vol. II, dated June 14, 1879, in which the chapter on *Circumstances* is made Chap. VIII, that on *Utility*, Chap. IX, and that on *Progress*, Chap. X, conforming to the final arrangement. From this, too, the Chapter on *Melioration* (XV) is omitted. The chapter on *Knowledge* here becomes Chap. XIII, and the division into parts is no longer maintained. The secondary titles of all the chapters are greatly changed, but none of them assume the final form. There was nothing upon which I reflected so much as upon the logical arrangement of these chapters.

On Sept. 8, 1879, I commenced the systematic revision of Vol. II. By this time I had decided to have that volume begin with the chapter that had always been called *Circumstances*, and I began with that volume. The first work was to read the old manuscript about which I say: "It is on the whole better than I expected and I shall be able to use a good deal of it." But there was much more to say on the subject, and for ten days I wrote entirely new matter to precede the matter already written. About 100 folios of this new introductory matter were written, and on the 20th I commenced revising the old. On examining the manuscript I find that most of the old folios were rejected altogether. Some were copied by Mrs. Ward, as in the case of the chapter on *Society*. But the greater part of the whole is entirely new matter. The long discussion of optimism and the anthropocentric theory was wholly new, and the concluding portion, "Statement of the Argument," "Definitions," and "Theorems of Dynamic Sociology," were all written at that time. The whole was completed on Oct. 19th. I find separate memoranda relating to all this in the miscellaneous matter. Chapter IX, *Utility* was taken up on the

20th and put through in exactly the same way. It was finished on Nov. 5th. The revision was even more drastic, as this was the first chapter written and dates back to 1869. Still some of the old folios remain with very few changes.

Spencer's *Data of Ethics* had now appeared and I read it in September, 1879. I therefore interrupted the revision of Vol. II at this point long enough to append to my chapter on *Spencer* (Chap. II) a brief discussion of this work. It was written on Nov. 6th and 7th, and occupies pages 215–217 of Vol. I.

The revision of Chapter X, *Progress*, was begun on Nov. 8, 1879. It was a prolonged task. The long treatises on government and religion had to be overhauled, and both were largely rewritten. The same method was followed, but on account of the greater recency of the first writing, a larger percentage of the old matter was retained. On Dec. 19th, occurs this entry: "Wrote very rapidly and finished the chapter on Progress, wrote 20 pages, the most I ever accomplished at one sitting." This hasty manner of work, however, left certain defects, and on Jan. 2, 1880, I "made some important changes in the treatise on government," and continued perfecting various parts till the 9th, when I pronounced it finished. The very next day I attacked the 11th chapter, *Action*, which occupied me a little less than a month. After first reading and roughly revising the old manuscript, I began the final rewriting and revising on Jan. 11th. The need of a systematic classification of actions was the first fact to confront me. On the day last named this entry occurs: "At 6 I went out and took a long walk during which I worked out a thorough classification of actions, which I drew up as soon as I got home, and proceeded to write the chapter." On the 14th I had reached the point where I could embody this classification in the manuscript. It occurs on page 314 of Vol. II. The treatment of dynamic actions which begins on page 376 of the printed volume was written on Jan. 26th and 27th. On Feb. 1st I commenced writing the longer discussion of the nature of the indirect method of conation with profuse examples, which begins on page 385. On Feb. 6th I completed the chapter. The manuscript shows that while the most of it is new there is quite a sprinkling of the old folios remaining. Chapter XII, *Opinion*, was begun immediately and finished on Feb. 25th. In the early and central parts much old matter stands, but the latter part, beginning with *Dynamic Opinions* on page 457, is entirely new.

On Feb. 29, 1880, there occurs this item: "At 7–30 I sat down to my book and completed my general table of contents." I am not certain what this table was. I find a table written in pencil on official letter paper which may be the one. Perhaps I began this at the office and brought it home to finish. Its somewhat modern character is attested by the occurrence for the first time of the phrases "Primary Aggregation, Secondary Aggregation, Tertiary Aggregation," as they were ultimately introduced. But it also contains the archaic feature of the division of the volumes into parts, and the retention of the final chapter on *Melioration*. In numbering the chapters I seem to have gone back to the old way of numbering those of each part separately. All this is very puzzling. Still, this seems to be the table that was drawn up at that time.

On Feb. 27, 1880, I commenced the revision of Chapter XIII, *Knowledge*. This was scarcely a revision. A smaller number of the original folios remain than in any other chapter except Chap. IX. It was finished on March 22, thus completing the entire work with the exception of the chapter on *Education* (XIV). The question then arose whether that immense chapter could be gotten into the book within reasonable limits. To answer that question I undertook a new count of folios of both volumes. The figurings on this occasion are not preserved, but the conclusion was that Chap. XIV must be restricted to 300 folios. As the old manuscript contains 650 the amount of condensation required was over 50 per cent. But as it had been written so long ago I had considerable curiosity to know how it would sound to my more enlightened ears, and I resolved to read it. I began on March 23, 1880, and finished on the 28th. I made no changes, but annotated it on separate slips. I have already described this work, and also my recent second reading and the result (see supra, pp. 167, 168). Having thus decided to write Chap. XIV *de novo*, I set in to do so on March 30, 1880, and on April 19th it was written. The revision took till the 24th. On that day I made this record: "Let everything else go and worked at the revision of my last chapter. Got it done at about 7 o'clock. This completes the second volume and the entire work."

On the 26th of April, 1880, I got my manuscripts all out, arranged the chapters according to the latest decision, cut two little pasteboards for each chapter, and put the chapters between these pasteboards. I wrote the number of the chapter on the upper pasteboard, and I have kept them all in this form from that day to this. I had been strongly feeling the need of some means of knowing when and where I had written certain things or worked up particular subjects. My memory was wholly inadequate to this, and I resolved to prepare an index of the entire work for my own use if for no other. Accordingly, on April 27th I began such an index. Of course it must be a slip index at first. The Bureau of Statistics had made a change in its library cards and a great number of the old obsolete cards were left over which could not now be used. As librarian of that Bureau at the time, I was called upon to dispose of these, which were then mere rubbish, and I had thought of sending them to the rubbish heap, as they occupied needed space. I then bethought myself that I could use them for my index, and so I carried them home and made my index with them. The making of this index was a prolonged affair. I took the book up in its order, finished indexing the *Introduction* on April 30th, chapter I on May 5th, II on May 8th, III on May 11th, IV on May 14th, V on May 16th, VI on May 17th, and VII on May 28th; thus completing the first volume. Vol. II was begun on May 29th and Chap. VIII finished on May 31st, Chap IX on June 2d, Chap. X on June 8th, XI on June 11th, XII the 13th, XIII the 17th, and XIV the 20th; finishing the slip index after nearly two months' labor. From June 21st to 24th I prepared the table of contents, first on slips like the index, which I then copied into manuscript. The vast mass of index slips had now to be arranged in alphabetical order. This was begun on June 25th, Mrs. Ward assisting. As soon as the letter A had been perfectly arranged I commenced (June 26th) to prepare the manuscript of the index, Mrs. Ward completing the arranging of the other letters so as to keep me going. It took till July 11th to complete this work.

As always happens, there were many incomplete references, and I now proceeded to supply these, which occupied me till July 15th, so far as I could do them without visiting the libraries. On the 16th I "prepared a final title page, and outlined the preface." The preface was "copied" on the 17th. The bibliography, or "List of the principal authorities referred to," was begun on the 18th, first on cards, which were finally reduced to manuscript form, but before this could be completed I was obliged to make a number of prolonged visits to the Library of Congress and other libraries. It was practically done on July 24th. I have already spoken (supra, pp. 154, 155) of my habit of recording "desultory thoughts," or "inspirations," and of the great number of these that had accumulated. On July 24th I commenced working these into the manuscript at their appropriate places, and as fast as they were thus introduced I would transfer the original slip to another envelope marked "inspirations used," so as not to use them more than once. I have just (Dec. 5, 1910) taken the trouble to look this envelope through, though not to read them. Their name is legion, and on each one is marked the chapter and manuscript folio at which it is inserted. On July 26, 1880, after much reflection, I changed the word "Circumstances" to "Adaptation" in the title to Chapter VIII. In the manuscript I see that I actually erased the former and inserted the latter word. I spent much time at this stage in going through the book and taking out "bad pages" which were neatly copied by Mrs. Ward. The question of placing mottoes and apt quotations at the heads of chapters also occupied me, and I collected a large number of such. I finally decided to omit this feature on account of the space it would require. The only one used was that of Socrates placed on the title page. It occurs in the *Memorabilia*, Book I, Chapter II, Section 50. On August 7th and 8th I rewrote the preface, greatly improving it, as I thought. On Aug. 13th and 14th I drew up the synoptical table of contents which precedes the analytical one of Vol. I (p. xiii).

The book was now done and ready for the

press, and the all-absorbing question was how to get it published. It was a large two-volume work by a wholly unknown author on a deep philosophical subject, far below all the current ideas afloat in the public mind, and such a book could scarcely prove a successful business venture for any publishing house. I began to be free in making the fact known among my personal friends that I had written such a book, and I consulted Dr. Coues, Dr. Baker, Dr. Welling, Mr. Peters, and especially Major Powell, with regard to it, and to the chance of publication. Major Powell encouraged me strongly, and in the end greatly helped me. I was particularly anxious to have the Appletons publish it. That was the house that was at that time bringing out the great scientific works in this country. The works of Lyell, Darwin, Spencer, and other leading writers were from their press, and they were also publishing the *International Scientific Series* and the *Popular Science Monthly*. I aimed high. I wanted my book to stand alongside of these with all the prestige that a great publishing house could give it. Major Powell wrote to Dr. Youmans about it, after reading much of my manuscript, and urged its publication by the Appletons, of whom he [Youmans] was the scientific advisor. I decided to attend the meeting of the American Association for the Advancement of Science in Boston in August and September, and to read a paper or two from my book before the section of Anthropology (see Nos. **105**, **106**, Vol. II, pp. 267 and 269), and if possible to meet Dr. Youmans there. He had expressed a desire to see the manuscript, and I took the whole of it along in an immense valise that I bought for the purpose. On Aug. 30th I met him at the table in the Hotel Vendôme, Boston. The interview was brief, but the next evening I spent with him in the hotel parlor and we canvassed the whole subject. He gave me little encouragement, but was much interested, and asked me to send the manuscript to him in New York. I packed it all up in my room the next day, and on Sept. 2d, I sent it to New York by express. After his return he read a good deal of the manuscript, and wrote me several very complimentary letters, saying that he would lay the matter before the publishers, but feared to recommend its publication as a business venture. He represented that his relations with them made it a kind of "dog's life," for if he recommended anything that did not pay in dollars and cents he was severely censured. At last, on Dec. 6th, he wrote me that he had brought my book squarely to their attention and they had declined to publish it at the usual rates. I wrote him to hold the manuscript awhile, and that I might come after it later. I investigated the Authors' Publishing Company, and decided against that. Several other publishers were consulted, including Holt and Houghton. On Feb. 2, 1881, Dr. Youmans wrote me an encouraging letter, in which he advised me to come on and go with him to see Mr. Henry Holt about publishing the book. I went that night and the next day called upon him in his sanctum. He went with me to see Mr. Holt. The interview was very pleasant, and after Dr. Youmans left he invited me to lunch with him at the University Club. It was arranged to send him the manuscript for examination at his leisure. On March 1st I received a letter from Holt declining to publish the book, and putting it chiefly on the ground that he did not agree with me on my main propositions relative to state action. He defended *laissez faire*, and did not want to publish books opposed to it. He recommended several Philadelphia publishers. I did offer it to Henry Carey Baird, who declined it without seeing the manuscript. Holt still had it, but I sent for it, and received it on April 7th.

It was in the spring of 1881 that I left the Bureau of Statistics and went on the staff of the U. S. Geological Survey to take up the study of the extinct floras of the United States. The change was so intensely agreeable to me that I plunged into my new work and almost forgot about the old book. When I started for a field campaign, however, I took the manuscript to the Survey and had it locked up in the money safe from July 25 to Oct. 10, 1881. The paper that I read before the Anthropological Society of Washington Dec. 20, 1881, on "The Anthropocentric Theory" (see No. 135, supra, p. 185) was read from Chapter VIII of the book. I have already mentioned (see No. 121, supra, p. 18) the large addition that was made to that chapter in April and May, 1882. The table of classification of phenomena on page 106 of Vol. II was drawn up on July 21, 1881. The original draft of it is among my papers.

In January, 1882, by the sale of a house that was heavily mortgaged and was keeping us poor, Mrs. Ward and I came into the possession of a little surplus which we both agreed should be used in publishing *Dynamic Sociology*, even if we had to bear the whole expense ourselves. Negotiations with the Appletons were reopened on the guarantee basis. Major Powell wrote them that they could not afford not to publish the book. On Feb. 4th Dr. Youmans wrote to me that they had consented to publish it, and on the 11th they sent me their terms, which I accepted. Foreseeing this, I had taken time by the forelock, and commenced putting the manuscript into condition for printing at once. On Jan. 29th I began a last and final revision of the whole work, starting with the *Introduction*. This was finished on Feb. 4th, and Chap. I was revised on the 5th, Chap. II finished on the 9th, Chap. III on the 11th, and Chap. IV on the 12th. On the 11th I wrote the dedication, and on the 12th I showed it to the Major and asked his consent to insert it. "He seemed considerably moved, and though extremely modest about it, he acted very grateful for the honor and appreciated it fully" [diary of Feb. 12, 1882]. I find the rough draft of the dedication among the miscellaneous papers, written in two forms, the first of which is erased and the second is as it appeared.

On Feb. 14th I sent on the *Introduction* and the first two chapters. Continued the revision and finished Chapters V and VI on the 13th. Commenced the long Chapter VII on the 15th and took Chap. VIII to the Museum to work on there. Major Powell was very liberal in his ideas of official duty. Most of his own philosophical writings were done in his office, and he did not hesitate to have his stenographers and typists take them down from dictation and engross them as part of their official duty. With him it was all for science and the public good. He knew I was preparing my manuscript there, and would come into my room and discuss all manner of subjects. Right here I might remark that when in the civil service I was always very punctilious, and never allowed my unofficial work to interfere with my regular office work. At the same time, when I look over that long period of my life from 1865 to 1881, I must insist that the only really useful work I ever did, work that counts in any way for the general good of my race—dynamic work—was wholly unofficial. I have often thought that sinecure positions when filled, for example, by such men as Isaac Newton and John Stuart Mill, are among the great agencies of human progress.

The final acceptance of the book by the Appletons was received on the 16th and the articles of agreement on the 18th. A sample page arrived the same day. There was an objectionable clause in the agreement about disposing of unsaleable copies that Major Powell and Mr. Spofford advised me to have erased, and I also wished to reserve the right of translation. Both these changes were willingly accepted by the publishers. The amended articles were signed on the 24th. The revision of Chapter VII was completed on March 5th. It was at this time that I interpolated the discussion above mentioned of the classification of phenomena into Chap. VIII (see No. 121, supra, p. 18). This was begun on the 9th, but suspended on the 12th, awaiting the appearance of my second article on the "Scientific Basis of Positive Political Economy." On the 12th I revised the whole of Chap. IX and began Chap. X. On the 13th the first instalment of galley proof arrived. The revision of Chap. X was completed on the 19th, that of Chap. XI on the 28th, of Chap. XII on the 29th. On April 1st more copy was called for, and I proceeded to get the rest of Vol. I ready and sent it on the 3d. The revision of Chap. XIII was begun on April 7th, but was interrupted to complete Chap. VIII by inserting the second article from the *International Monthly*, which arrived on the 18th. My article on "Kant's Antinomies in the Light of Modern Science" (see No. 120, supra, p. 1) had appeared, and copies reached me on April 20th. There was something in that that I wanted to add to Chap. VIII, and I proceeded to do so (see Vol. II, p. 27). The revision of Vol. II was completed on April 20th, and the manuscript of that volume was sent to the publishers by express on the 21st.

On May 2 and 16, 1882, I presented an elaborate communication to the Anthropological Society of

Washington on "Society as a Domain of Natural Forces," which was illustrated by charts and embodied the main argument of Chapter VII, but as the manuscript of that chapter was then in New York, and the proof had not yet reached me, I could only discuss the charts and the whole subject from notes. But of course it was then perfectly familiar to me, and I needed no manuscript (see No. 163, infra, p.).

By the 18th of May, 1882, a large amount of page proof in second revise had been received, and I saw that I could gain much valuable time and avoid pressure later on by beginning to prepare the index. But when I started to do it I perceived that the work would be immensely facilitated and the manuscript rendered far more useful if there were indicated on it the beginning and ending of the printed pages. I used a blue pencil for this and drew lines across the folios on which two printed pages occur. Later I used red ink, but both are clear, and in all my manuscripts, not only of this but of my subsequent works, one may open them anywhere and tell at a glance just what page in the volume any manuscript folio corresponds to. The lines crossing the folios of course usually also cross a line, and this is always exactly where the printed page ends. If a word is divided at the bottom of the page the line passes between the syllables. This was always the first work to do when the final page proofs arrived. It is considerable labor, but is fascinating work and amply repays its cost. Before I began the index proper I had some conversation on the subject with Dr. Baker, and he suggested that I make an "index-register," i. e., parallel columns for folio and page numbers, and I adopted his suggestion. I do not find this index register among the manuscripts. It will be remembered that after indexing the manuscript on cards I reduced the whole to manuscript form. This manuscript exists, and throughout it the folio numbers in Arabic and the chapter numbers in Roman are crossed out and the number of the volume in lower case Roman and of the printed pages in Arabic are written, all in red ink.

I received regularly two sets of galley proof and two of my friends, Dr. Frank Baker and Mr. Edward T. Peters, volunteered to read one of the sets, which they gave back to me with their suggestions in time to make any necessary changes in the page proofs when they arrived. Another person who helped me very much was Mr. W. B. Taylor, editor of the Smithsonian publications. He was of that fine type of mind that I could freely consult, and I frequently did so. On June 30, 1882, he and I wrestled a long time over my four stages of society, and it was then that, with his help, the paragraph relative to them on page 466 of Vol. I was brought to its final form, and the words "antarchic," "anarchic," "politarchic," and "pantarchic," were adopted. With the exception of *anarchic*, all these words were, I think, here used for the first time. "Antarchic" occurs in the *Standard Dictionary*, without reference, and in the *Supplement* to the *Century Dictionary*, with reference to the *American Journal of Sociology* for January, 1901, where it occurs in an article by Dr. Small on page 505, where he quotes the passage in *Dynamic Sociology*, and cites the page in a footnote! This is the more remarkable as the other two, "politarchic" and "pantarchic," are also in the *Supplement* to the *Century Dictionary*, and are both credited to me, and the page accurately given. This of course is far from defending this early theory of the nature of society and origin of the state (see my article on "Sociology and the State," pp. 679–680, No. 553). Proofs continued to come with some interruptions to the end of the year, and I kept up the index register in the manner described. On Sept. 27th I made some changes in the treatise on religion in Chap. X. Vol. I was in final page form early in October, and it was not till then (Oct. 9th) that I commenced the index proper, changing copy folios and chapters of my index to the manuscript to page and volume of print. Galley proofs of Vol. II began to arrive on Oct. 13, 1882. The discussion on pages 371–373 of Vol. II, relative to the ethical code being self-enforcing, was added to the galley proofs on Dec. 2, 1882. By the end of the year composition had begun on the last chapter and about 400 pages were in forms.

On Jan. 5, 1883, I remodelled the preface, but just what I then did I cannot now tell. On the 8th all the preliminary part was made ready to go to the printer, and it was sent on the 9th. The bibliography was next taken up and put in shape. It was finished on the 12th, and mailed on the 13th. The last galley proof of Chap. XIV, i. e., of the text of the book, was received on the 16th. On that day occurs this entry: "Wrote a rough draft of a closing paragraph making the proper acknowledgments." This was revised and sent the next day. It still stands in the manuscript as part of the preface. Proof of the preliminary parts of the book came on the 17th, including of course the dedication, and I took it down and showed it to Major Powell. I also showed it to Dr. Baker and Mr. Peters, and both of them advised me to make a separate head of the acknowledgments. I took their advice, and on the 22d I received proof of these acknowledgments. I sent this proof to Dr. Youmans. In the manuscript I had said, "Professor Edward L. Youmans, who, though expressing from the outset his non-concurrence in the leading propositions which the work was written to establish, has, nevertheless, from the true scientific spirit of courting free inquiry, insisted through good and evil report that it deserved a hearing." On the 24th "I received back the proof slip I had sent to Youmans with quite a letter written on it by him. He would not let me say he non-concurred in the work." As a result it had to be reduced to its present form. The following paragraph was also in the manuscript:

"I am also indebted to Mr. W. B. Taylor, physicist of the Smithsonian Institution, for the careful revision in the proof of certain passages relating to his specialty and for valuable emendations in the same."

As soon as he saw this in the proof he utterly refused to allow me to say it, and I was very reluctantly compelled to strike it out. The bibliography was all set up, and I received the galley proof of it on Jan. 27th. The last page proof of the text (page 633) was received on the 29th. I was then able to complete the index to that point. Manuscript of the index was called for on Feb. 7th, but I did not wish to send it in the rough form, and made them wait till I could rewrite it. It was a great labor first to get it all ready to copy, and in this Mrs. Ward assisted me constantly. It was finished on Feb. 24th, and I commenced making the final manuscript for the printer. The reader knows how thorough it is. I mailed the first two letters on the 26th, so that composition could be begun. Then I went on and finished the index on March 15th. The manuscript is all preserved except the first 30 folios, which are missing. This takes nearly through the letter B, and must have been the first instalment that was sent on the 26th. Its absence is unexplained. The index was then slowly put in type, and the last plate proof was received on April 25th. In the meantime the plate corrections had been sent on and made. On April 28th I received a letter from D. Appleton and Co., saying that the book was in press and would be out in fifteen days. On the 30th I received a long letter from Youmans in which he expressed himself as very dubious about the success of the book, to which I replied at length on May 3d. On June 1st he informed me that the book was out, and I went to Brentano's on the 2d. Mr. August Brentano (the old gentleman and head of the firm, whom I knew), showed me a note from the Appletons dated June 1st, saying that it was not out yet, but Youmans telegraphed me that day that 25 copies (sets) had been sent me by express. The next day was Sunday, but I resolved to get the books if possible. After some search I succeeded in finding the box at the Baltimore and Ohio Railroad freight office, and our colored man Richard Colston wheeled it home. After opening it Mrs. Ward and I "had a feast examining the books." On that day I wrote: "The great end which I have had in view for fourteen years is at last achieved. It is certainly the proudest day of my life."

On June 8th Youmans wrote me that 134 orders had been received for the book on the day it was published. I may say here, as some may be curious, that while of course the sales have never been large, they have remained nearly uniform throughout the thirty years that the book has been on the market, with a tendency to increase rather than to diminish. In winding up the business I wrote for a statement of the account. There was a balance due the publishers according to the agreement, and that balance I paid by draft which I sent them on June 18th, the day I received the itemized account. This was purely accidental as to date, and my comment upon it was this: "This is the last act in the drama of the Dyn. Soc., and happens to have been done just 14 years after the first scratch was written."

I need not repeat here any of that part of the history of *Dynamic Sociology* that is given in the preface to the second edition. The little book on Comte, mentioned on page xxii of that preface, was received from Mr. Lessevitch on Nov. 24, 1896. The translator of all the essays, including mine, was I. I. Spiridonoff.

I distributed the book as widely as I was able, and I received a great many letters that I would be glad to insert here. I will, however, confine myself to two, the source and character of which will, I think, in the judgment of all, justify this course:

LINDEN, WELLINGTON, SOMERSET,
June 28, 1883.

DEAR SIR: On returning here yesterday I found your two volumes on *Dynamic Sociology*, which I do not wish to leave without acknowledgment till they have been read through, which may be weeks hence. I see in it an attempt at some of the greatest modern problems, made with a logical force and knowledge of the subject which may give your arguments practical importance in the world.

Among other topics I found your remarks on the relation of H. Spencer to Comte very interesting, and I happened also on your attempt to find the genesis of modesty, which struck me as highly ingenious. I have some scattered evidence bearing on this curious point, and hope one of these days to compare your theory with these facts and see how they fit.

Till I have gone through the whole book I need not say more, except to thank you for a work dealing seriously with the practical bearing of anthropology on society, which so few students have as yet realized.

I am very sincerely,

EDWARD B. TAYLOR.

LESTER F. WARD, Esq.

The other letter is as follows:

38 QUEEN'S GARDENS, BAYSWATER
LONDON, July 2/83.

MY DEAR SIR: I have to acknowledge with thanks the copy of your two volumes on *Dynamic Sociology* which recently reached me.

I am at present so much out of health that I neither can do any writing nor any reading; and I fear it may be long before I shall be able to give any such attention to your work as it well deserves. From such few glances at the heads of chapters and their contents as I have allowed myself, I infer that you have a good deal more faith in the effects of right theory upon social practice than I have. The time may come when scientific conclusions will sway men's social conduct in a considerable degree. But as you are probably aware, and as, in fact, I said very emphatically when in America, I regard social progress as mainly a question of character, and not of knowledge or enlightenment. The inherited and organized natures of individuals, only little modifiable in the life of a generation, essentially determine for the time-being the type of social organization, spite of any teaching, spite even of bitter experience.

In respect of this belief I gather that you are at issue with me, and hence hope much more from a constructive social philosophy than I do. Nevertheless, I regard all works which draw public attention to sociology, scientifically considered, as calculated to raise useful discussion, and I hope your work will be widely read.

I am truly yours,
HERBERT SPENCER.

LESTER F. WARD, Esq.

It is rather remarkable that Mr. Spencer, with so little study of the work, should have caught so readily and correctly the fundamental distinction and radical opposition of his school of thought and my own. The reader of this historical sketch knows how vital that distinction was to me, and I may add, that, instead of being influenced in the opposite direction by the views of Galton and Ribot, and that school, I have become more and more firmly fixed in my original convictions. In my *Applied Sociology* I found my first opportunity to bring out the contrast and prove my position.

I cannot complain of the reception given the book from the press. As the *Popular Science Monthly* was published by the Appletons it was of course to their interest to give it a good send-off there, and the result was the somewhat extended review drafted by myself at Dr. Youmans's request, and more or less remodeled and expanded by him (see No. 143, supra, p. 134), and which appeared two weeks in advance of the book. Though, in its final form, not wholly favorable, it was of course sympathetic and appreciative, and greatly helped to give the work a vogue among scientific men. A much more important impulse in the same direction was given it by Major Powell's exhaustive review in *Science*, consisting of four articles in the numbers for July 13th and 27th, and August 10th and 24th, respectively, to which I contributed a portion of the first (see No. 156, infra, p.). This review is almost wholly favorable and highly commendatory, and was unquestionably the highest compliment and the greatest help the work has ever received. The concluding paragraph of the fourth and last article is as follows:

> In the short articles of this review an attempt has been made to give a synopsis of the work in question, to show the relation of Dynamic Sociology to current philosophy and to point out its more important defects. Little space is left for that commendation which its intrinsic merits deserve. Mr. Ward's presentation of the subject is simple, clear, systematic and courageous. For its preparation he has explored vast fields of thought; and his conclusions, however they may be questioned, cannot be ignored by those who are interested in modern philosophy. Ward's *Dynamic Sociology* is America's greatest contribution to scientific philosophy.

But neither of these reviews can be regarded as disinterested. The reader acquainted with the history of the work will naturally discount them as emanating from other motives than the pure objective recognition of its merits. The same might be said for the excellent and highly complimentary review in the *New York Times* for July 30, 1883, because, though a much smaller number knew it, it was written by my friend, Dr. Wm. B. Owen, whose interest in and admiration for the work while it was being written have been recorded in this sketch (supra, pp. 166, 182). A still less disinterested character of course had the reviews written by myself for the *Washington Evening Critic* of June 1, the *Washington Post* of June 3d, the *Washington Capital* of June 10th, and the *Washington Evening Star* of June 23d (see Nos. **146, 147, 148, 151**), which all appeared anonymously, and must have exerted some local influence. Anyone who should read all these consecutively would not suspect that they were from the same pen, as in each case I presented the work from a different point of view. But there was no lack of independent reviews. As they began to come in from all sources Mrs. Ward became impressed with the importance of collecting them and preserving them in a systematic way. She began this work by procuring at a book store a copy of "Mark Twain's Adhesive Scrap Book," which she was not long in filling, and had to get another and fill that. But now she extended the plan to include all press notices of my works and writings arranged chronologically, and this she continued to keep up as long as her health permitted. Since her health broke down in 1908, I have continued this work as fully as my time would allow, and there are at the present date (1911) seven volumes of press notices, but beginning with the third much larger albums were used, the Mark Twain scrap books proving wholly inadequate.

Many of the reviews were, as in all cases, wholly perfunctory and valueless, but a large number are more or less extended and written by able reviewers. Among such may be mentioned those in the *Boston Advertiser*, *Philadelphia Times* and *Inquirer*, the *Montreal Star*, the *Chicago Dial*, the *Boston Transcript*, the *Woman's Journal*, the *Rochester Post-Express*, the *San Francisco Bulletin*, the *New York Evening Post*, the *Home Journal*, the *Christian Register*, the *New York Independent*, the *Hartford Times*, the *American* (Philadelphia), the *Catholic World*, and other American journals. Several of the British quarterlies noticed the work, but briefly for the most part. The only extended treatment occurred in the *Westminster Review* for October, 1883. It is not signed, but is ably written and goes decidedly to the merits. It is almost wholly favorable. In fact there were no entirely hostile reviews, even that in the *Catholic World* being very respectful. For I would not class Mr. Grant Allen's review in the British journal *Mind* for April, 1884, as entirely hostile, although it is highly critical and calls in question a large number of my conclusions. In my *Applied Sociology*, pages 104–105, I have given a sample of the reasoning of this review, and that Grant Allen was considerably influenced by my views may be judged from what he says early in the review, which I also quoted in *Applied Sociology* (p. 297) and still more from a much later remark of his which I repeated on the next page of that work.

The question whether a book is a "success" or not depends largely on the meaning given to that term. But even if it has been a business failure, it has at least been a moral success.

I did not discover until 1898 that the publishers had reprinted *Dynamic Sociology* in 1894. The mere striking off of additional copies to supply the market would have been no more than to comply with the terms of the agreement, but they changed the date on the title page so as to imply that 1894 was the original date of the work. Such an outrage upon an author cannot be characterized in respectable terms. The book was full of original ideas and after eleven years these had begun to be diffused throughout the world. Anyone who had imbibed them reading the edition of 1894 would naturally accuse me of uttering commonplaces if not of plagiarism. This in fact has frequently been done. Barth, in his *Philosophie der Geschichte als Sociologie*, Leipzig, 1897, p. 167, in treating my work, appends a footnote, citing the edition of 1894, and saying that I seemed no longer to recognize an edition which, according to the preface, must have appeared in 1883. I do not recognize the edition of 1894, about which I was not consulted, and I repudiate it. There is another similar reprint, dated 1902, which is really the 2d edition, but that fact is not stated on the title page; and still another like the last named, dated 1910.

In complete ignorance of the above, and inferring from the publishers' statements of sales that the first edition must be about exhausted, I wrote to the Appletons on Feb. 13, 1896, proposing the bringing out of a new edition. A large number of typographical errors had been brought to light which I wished to correct, but otherwise I did not care to revise the work at all. But in view of the great prominence that sociology was assuming, I wanted to write a new preface. I also wanted to include in the preface an account of the treatment that the work had received in Russia. In my letter I proposed that the price, which had been $5, be reduced to $4. In their reply of April 15 they expressed a willingness to issue the second edition, and also to reduce the price. I wrote again on May 6, inquiring as to the amount of stock, and was surprised when they said in their reply of the 12th that it was sufficient to last through the year. They did not tell me they had published an edition in 1894 without consulting me. They said that January, 1897, would be a suitable time to issue the second edition, and that November would be soon enough to send on the new preface. On Nov. 1, I commenced getting the data together for writing the preface, which occupied me until the 26th, when I finished it. I then prepared the plate corrections. Sent both on the 29th, and received proof of the preface on Dec. 4 and of the plate corrections on the 9th. The title page had to be changed, and a new one was adopted with a complete change of type. The objectionable commas were removed. A proposition made by me on Dec. 22d, and accepted by the Appletons on the 25th, to issue the new preface as a pamphlet, was subsequently abandoned. My part was all done in December, but the second edition did not appear till April 21, 1897. It was held back to work off that 1894 edition, as seen by a letter from the company dated Feb. 23, 1897, in which they say: "As there are a few copies of the old edition still on hand we have felt that it was not important to issue the book immediately. In fact, as the times are improving, we have thought it just as well to wait until March or April before publishing."

On March 20, 1902, I received the following letter and enclosure:

NEW YORK, March 19, 1902.

LESTER F. WARD, Esq.,
The Magnolia, 1321 M St., N. W.,
Washington, D. C.

DEAR SIR: We received from the Western Co-operative Association of Trenton, Missouri, a letter a copy of which we inclose you herewith. We do not know anything about this Association, but probably it might be an advertisement for the *Dynamic Sociology*, to sell them 250 copies of Volume II, if they will take them at 80 cts. each. Of course, we could not pay the full coypright on these copies, and would propose to pay you 15 cts. for each copy thus sold.

We should be glad to know whether you know anything about this Association or the magazines they refer to, and to have your opinion as to the advisability of making such a sale.

Yours very truly,
D. APPLETON & COMPANY,
WM. W. APPLETON,
President.

OFFICE OF WESTERN CO-OPERATIVE ASSOCIATION

TRENTON, MO., March 11, 1902.

Messrs. APPLETON & Co.,
13th St. & Fifth Ave., New York.

GENTLEMEN: About two months ago I had a talk with one of your managers about Mr. Ward's *Dynamic Sociology*. If you will print a special edition of the second volume of this book (the first is too antagonistic to religion for us), we will advertise it as "The Great Solution of the Social Problem and the Problem of Life" in our magazine *Young Oxford*, published at Oxford, England; we will adopt it as a text-book for our 2800 students at Ruskin Hall, scattered throughout England; we will adopt it as our text-book in Sociology in Ruskin College, Trenton, Mo.; will advertise it continuously in a large way in *The Multitude*, which you will see on all the news-stands in New York City and the United States, and also in our new paper to be printed at Trenton, Mo.

If, in exchange for all this advertising, you will sell us a few hundred copies at cost, we will be satisfied. We will give you either $80.00 for 100 copies, or $160.00 for 200 copies to start with, cash; besides, we will act as your agents in selling this book and pushing its sale throughout England and the United States.

If you decide to print an extra edition could you not spare 20 or 30 copies of those you have on hand at once, so that we could begin our work? We would advance you the full $80.00 to prove good faith.

We expect to be able to handle quite a number of Herbert Spencer's *Sociology* for collateral reading. Write your best possible terms for this by the dozen, and what further reduction you will make if we will extensively advertise the same.

(*Signed*) Very sincerely yours,
WALTER VROOMAN.

I replied to this letter, approving the project, and accepting their terms. On April 3d I received the following letter:

NEW YORK, April 2, 1902.

MY DEAR SIR: Mr. Walter Vrooman wishes to publish in the June number of his magazine, *The Multitude*, a biographical sketch of you and a general write up descriptive of your philosophy. For this purpose we would be pleased to have your photograph and some biographical matter which is doubtless in print.

The Multitude, has sent cash to Appleton & Co. for the whole of an extra edition of your book, which we will circulate simply because we believe yours is the greatest philosophy of modern times. We would appreciate it if you could find time to give us an article of 1500 words on "The Evolutionary Point of View in Modern Thought," or something similar, for the July number. The biographical matter and the photograph we would be pleased to have by May 1 in preparation for the June number. Thanking you in advance, I am,

Sincerely,
WADE MOUNTFORTT,
Managing Editor.

MR. LESTER WARD,
Smithsonian Institution,
Washington, D. C.

On April 13th I wrote to Mr. Mountfortt and sent him a photograph. In my letter I told him that I would rather not write such an article myself, but that I would be very glad to assist him in any way in preparing such a sketch as he desired. I sent him some documents and gave him certain references. On the 23d he sent me the sketch he had prepared. I examined it, added considerable biographical matter, and returned it on the 27th with my approval. I requested that a supply of reprints be struck off containing the portrait, and that I be furnished with a large number of them. There was considerable delay, but proof reached me on June 15th, which I read and returned. On June 25th I received gratis 200 copies of the little booklet consisting of the article with the portrait as a frontispiece, a title page and a neat cover bearing the words: "Lester F. Ward and his Book Dynamic Sociology." It is prefaced by a note signed by The Multitude Publishing Co. These are reprints from *The Multitude*, A Monthly Magazine, New York, Vol. I, No. 5, July, 1902, pp. 1–2. Mr. Walter Vrooman is put down as its editor. The following words stand at the head of the article in *The Multitude*, and do not appear in the reprints:

The True Method of Human Progress.

Lester F. Ward, the American Philosopher: His Wonderful Book, Dynamic Sociology.

It will be observed that this portrait is not the same as any that have been published since (see Nos. 522, 551). The photograph was taken on Aug. 6, 1886. The Cosmos Club proposed to have a great photograph album to contain the portraits of all its members, and we were requested to furnish our pictures for it. It was on that occasion that I sat for this photograph. On Jan. 17, 1898, or nearly twelve years after they were taken, I asked Mr. Prince, the photographer, if the negative still existed, and he searched for it and found it. It was at that time that the particular view here in question was printed from the negative of 1886. I introduce here Mr. Mountfortt's article entire with the portrait, as a part of the history of *Dynamic Sociology*.

THIS booklet contains the greater part of an article on Lester F. Ward, the American Philosopher, and his book Dynamic Sociology, which was published in The Multitude Magazine, July, 1902. In view of the fact that so little of a biographical nature concerning Mr. Ward is to be found in the various encyclopædias, and the further fact that Dynamic Sociology seems destined to take rank as the handbook of modern progress, it is deemed just to Mr. Ward to put the review in this form for the use of his readers, friends and admirers.

THE MULTITUDE PUBLISHING CO.

New York, July, 1902.

[3]

LIBRARIES throughout the country report a renewed demand for literature of a philosophical and sociological nature, and this fact is largely due to the increasing interest in the works of Lester F. Ward, the eminent American philosopher. Appleton & Co. have recently put forward a second edition of his masterly book, *Dynamic Sociology*, which was originally published in 1883. Strangely enough, this, the most exhaustive and thoughtful contribution to the literature of social science, has only recently sprung into anything like general popularity. Although it is the most profound, as well as the most entertaining work of its character extant, it has been practically overlooked by even some of the closest American readers of philosophy. It remained for Russian censorship to attract attention to Mr. Ward's book when the advanced minds of that country had taken it up and indorsed its liberal doctrines. When it was translated into the Russian language the translation was promptly seized by the censor and destroyed by order of the ministerial council. Dr. Albion W. Small, editor of the *American Journal of Sociology*, credits the Russian censors with attracting the attention of Americans to this scholarly philosophical work.

He says: "At last Americans will discover, by the [4]
grace of the Russian censor's *auto-da-fé*, that an epoch-making book has been before their eyes since 1883, from the pen of one of their own countrymen, and only a handful of them have had the wit to discover it."

As a means of preparing one's self for an understanding of *Dynamic Sociology* Mr. Ward's concise and comprehensive volume, *Outlines of Sociology*, should be read. This work, dealing as it does with the origin, the data, the philosophy and the place of sociology among the sciences, is found to be excellent training for the student who would go deeper into the dynamics of this science which is inevitably to bring about a popular revulsion of thought. And it is obviously not a digression to consider right here what a stupendous revolution in theoretical and practical economics and social ideals there would be, if even the teachers of the public schools would acquaint themselves with *Dynamic Sociology*. And how much more tremendous and far-reaching would be the revulsion of social thought if the reading people throughout America were to suddenly absorb some of the philosophy so honestly and so boldly set forth in this work. From the chapter on the "Reciprocal Relations of Man and the Universe" to the closing paragraphs on "Universal Education," the second [5]
volume of Mr. Ward's book interprets a world of phenomena which was as a sealed mystery until his time. The first volume of *Dynamic Sociology* deals with the practicability of sociology as a science. It outlines, too, the fundamental data on which all philosophy rests, and, in a preparatory way, leads up to the wondrous and profound revelations of social phenomena.

Unlike most of the deep scientific literature, the work of Mr. Ward is presented in a charmingly interesting style, which not only renders it more comprehensive, but promptly establishes that consecutive flow of thought from author to reader which is so essential. Dealing with the motives of mentality, Mr. Ward says: "The pleasures of the intellect form a stimulus of great strength for the most highly developed individuals of the race, and, though restricted to so few comparatively, cannot be left out of account as motives to human action and ends of being. It is here that the purposes of nature and the purposes of man most nearly meet, and the means of nature become most nearly identical with the ends. For intellect alone can appreciate the results of its own efforts, so that, while the immediate exercise of the cerebral faculties forms the primary stimulus
[6] to mental labor, the point is at length reached at which this source of enjoyment is reënforced by a lively sense of the good which this labor is destined to accomplish, constituting a derivative pleasure even greater than the original one. Again, the quality of intellectual enjoyment is so far superior that it is in this sense raised above all other stimuli, and may be thus classed higher than its limited diffusion would otherwise justify, and assigned a place among the primary motives of human action. And, as the work of cephalization goes on, this must continue to become more and more widely diffused, until eventually the mass of mankind will experience the progressive impulse to brain exercise whose consequences are social evolution."

Further, upon happiness, as the realization of the positive forms of feeling, are these sentences:

"The above considerations are the logical outcome of a thoughtful study of the phenomena of feeling. It may seem strange to some that these phenomena should be thus placed at the very base of a philosophic system whose chief object is to exalt the intellect, and which expressly avows that only by *intellectual* culture and the increase of *knowledge* can the true progress of mankind be secured. There is an apparent incongruity between the doctrine, on the one hand, that progress consists essentially and [7] solely in the elevation of the feelings, the increase of pleasure, the elimination of pain, the intensification of sentiment, the creation and diffusion of new enjoyments, the encouragement of natural emotions, the gratification of the normal instincts, the satisfaction of desire, and the general pursuit of happiness; and the doctrine, on the other hand, that progress is to be attained solely through the cultivation of the intellect, the acquisition of knowledge, and the thorough and universal dissemination and enforced adoption of educational measures for the elevation and systematic development of the cold, objective faculties of the mind.

"To bring these two seemingly incoherent and incongruous doctrines into harmony, and to show the true mechanical dependence of the one upon the other, as cause and effect, is one of the primary objects of this work."

As to man's study of nature and the necessity thereof, Mr. Ward says: * * * "The greater part of all suffering is the result, direct or remote, of ignorance. Obviously, therefore, the first great duty of man is to acquaint himself with his environment. * * * The phenomena that lie on the surface are of little value. They mislead at every turn. Not only must the deep-lying facts, difficult of access, be sought out with great labor and perseverance, but [8] they must be co-ordinated into laws capable of affording safe and reliable guides to human operations. * * * In his pursuit of information with regard to the nature of the universe man must be deterred by no fears. * * * Man's right to probe and penetrate the secrets of the universe is unchallenged. It is only he himself who has ever ventured to question it. His active brain, filled with a thousand other delusions and imaginings, has fancied gods and demons outside of nature forbidding him to prosecute his studies. * * * The principal object which man has in the study of nature is to enable him to control its forces."

Of applied philosophy, Mr. Ward has this to say: "All philosophy aims to account for phenomena. The human mind is so constituted that no power can prevent it from perpetually striving toward this end. All systems of thought naturally fall, in this respect, under two general divisions, the *teleological* and theological, or divine free-will, or predestination and of fatalism. To this also should be added that modern dualistic school who hold that all
[9] phenomena are the result of unvarying laws once arbitrarily impressed upon the universe."

These few paragraphs give some idea of the depth of thought conveyed in a book which has far too long been allowed to slumber on dusty shelves. When readers throughout the land shall finally take up and peruse this work, a new trend of thought will take hold of the social universe. Such a time is not far distant. Mr. Ward is yet a man in the prime of life and he will live to see his philosophy read and accepted by the great force of thinking people on this continent. Of this there is the utmost assurance in the very fact that libraries are finding *Dynamic Sociology* and Mr. Ward's other books in active demand.

Outlines of Sociology was the outcome of a series of lectures which Mr. Ward delivered at the School of Sociology of the Hartford Society for Education Extension in 1894 and 1895. The volume furnishes an excellent introduction and groundwork for readers who would know the whys and wherefores of sociology.

Lester Frank Ward was born in Joliet, Ill., in 1841 and served in the Union army in the Civil War. After the war he went to Washington, D. C., which has since been his home. He was graduated from the Columbian University
[10] in 1869, and has since received several other degrees, including that of LL.D. He became chief of the Division of Navigation and Immigration and afterward librarian of the U. S. Bureau of Statistics. In 1881 he accepted the position of paleontologist in the U. S. Geological Survey, which he still holds. Primarily a botanist and

frequent contributor to the botanical journals, author of a *Guide to the Flora of Washington and Vicinity*, he became specially interested in the past history of plants and has contributed eight large illustrated memoirs to the publications of the Geological Survey.

Mr. Ward's *Psychic Factors of Civilization*, 1893, second impression, 1901, is regarded by him as his best work. All of his books have been translated into Russian, the *Psychic Factors* no fewer than four times, but only this and the *Outlines* were permitted to appear. The Polish translation of *Dynamic Sociology* was also suppressed. Mr. Ward is the author of many philosophical articles, lectures, addresses and memoirs other than those outlined here. He was also one of the collaborators of the Century Dictionary and of the last supplement to Webster's International Dictionary.

I never saw Mr. Vrooman himself but once and that was on March 12, 1904, when he called on me in my office at the National Museum. I had heard nothing from the scheme of his, above described, but he told me that it was carried out and the volumes distributed to the institutions he had founded. I understood him to say 500 copies, but he probably said 250. I wrote to the Appletons at once and reminded them of their contract with me. They replied on the 18th, giving some flimsy excuse, but sending me my royalty. I want to say with regard to that edition that, while I have never heard any echoes from its use in this country, I have met several persons who had been at Ruskin College, Oxford, and who told me that *Dynamic Sociology* was much in evidence there. Later I learned that 50 of the 250 copies went to that school. Still later, after I made the acquaintance of the talented principal of that school, Mr. Dennis Hird, I found that they were teaching not only Vol. II, but Vol. I, and not only *Dynamic Sociology*, but all my books and writings, and that my name was a household word with the students and professors of that college. Ruskin College was intended for the education of working men, but Mr. Vrooman had not taken the necessary pains to safeguard it from that point of view. Standing as it did under the very shadow of Oxford University, which is probably the most conservative educational institution in the world, it allowed the influence and power of that great obstacle to human progress to gain little by little control of its administration, and as soon as that control was complete the teaching of sociology and evolution, in fact of any of the kinds of knowledge that are useful to the working man, were inhibited, and Ruskin College ceased to be a workingman's college. A crisis arrived, a new labor college was founded, and the student body transferred its allegiance from Ruskin College to the Central Labour College. I chanced to be present at the founding of the latter, and I contributed my mite to the general result (see No. 551 of this series). There they are not only teaching *Dynamic Sociology* but *Pure Sociology* and *Applied Sociology*, and I have sent to that College every paper I have ever written of which I had an extra copy in 1909. Many of these latter have been reprinted in the *Plebs Magazine*, the organ of the progressive element of labor workers in England. It seems that the laboring classes of both England and America, and to a large extent the poor and oppressed of all lands, as notably in Russia, regard the teachings of *Dynamic Sociology* as tending to liberate them from their chains. I become a sort of Moses to them to lead them out of the wilderness of human thraldom.

146. [Notice of Dynamic Sociology]

History.—Written May 31, 1883. I gave this to Mr. E. T. Peters, who was working on the *Critic*, and he had it inserted as his own with appropriate modifications.

The Evening Critic, Washington, D. C., June 1, 1883.

THE author of the above work is a citizen of Washington, and belongs to the corps of scientific men to whom the Smithsonian Institution, the National Museum, and the Geological Survey furnish congenial employment. Although, like all these gentlemen, a specialist, Mr. Ward does not believe in narrowing a whole life down to the minute study of a single class of natural objects, and in the work before us he shows that his observation and reading have taken a very wide range. He has made his study of natural history include that of man and of society, and his book is a bold attempt to combine into one great system of mutually dependent objects not only all the forms of animal and vegetable life, but even inanimate things, the minerals, the rocks, the elements, and the celestial bodies. Seizing upon the new conception of universal development or evolution he fits everything into its appropriate niche in his progressive scheme of having man in his highest social stage at its head. In showing how this system of things has been evolved, the higher from the lower forms, our author is in entire harmony with most of the modern philosophers who set out with the facts of the known universe as the basis of their ideas, but at this point he finds himself compelled to diverge from the main path of the most advanced modern thought, and to introduce certain new elements which he regards as being of paramount importance. Without ascribing to man any divine attributes not originally attained through spontaneous evolution like all the rest, he does maintain that the development of the psychic faculty, and especially the appearance of the rational intellect of man, introduced a set of factors into the general problem of evolution which, notwithstanding a large amount of extravagant laudation, have not yet been assigned their true value.

Even the great English philosopher, Herbert Spencer, is found deficient at this point. The failure to recognize the true potency of these factors has rendered even this most profound philosophic system practically sterile so far as the good of man is concerned. The main object of Mr. Ward's book is to show precisely how human reason differs from all other agencies of evolution, by just what methods it normally works, what it has already done that is wholly distinctive from all that other influences have accomplished, and then from these established facts to demonstrate that it may be made to do much more still in the future.

A large part of the work is devoted to the herculean task of overthrowing the errors of human reason which counteract and now so nearly neutralize its normal and legitimate influence. In this he necessarily antagonizes much that is highly cherished by vast masses of men, and cannot fail to call down the wrath of many upon him, but nothing is clearer to the reader than that this labor is unsought and forced upon him; that he performs it bravely as a duty and not as a pleasure, and that his impulses, whether rightly or wrongly guided, are both honest and philanthropic. The subjects discussed are always of the highest interest, and the learning and ability brought to their treatment must command the respect and attention of scholars and thinkers, whatever their private convictions may be.

147. [Notice of Dynamic Sociology]

History.—Written May 28, 1883. I gave this to Mr. Henry L. West, City Editor of *The Post*, and he attended to its insertion in the Sunday issue.

The Washington Post, Washington, D. C., No. 1877, June 3, 1883, p. 4.

DYNAMIC SOCIOLOGY

DYNAMIC Sociology, or Applied Social Science as based upon Statical Sociology and the less Complex Sciences is the title of a work by Lester F. Ward, A.M., which has just been published in two volumes of 726 and 698 pages respectively by Messrs. D. Appleton & Co., New York. The author has been a resident of Washington for the past eighteen years and is well known to a large number of citizens, especially in scientific circles, as a quiet, hard-working naturalist, and more especially as a botanist. A year ago he gave us his *Guide to the Flora of Washington and Vicinity*, which was published by the Smithsonian Institution and has been videly distributed among the younger members of the community, particularly among the pupils and teachers in the public schools. We might have felt some little surprise at seeing the large philosophical treatise before us from his pen, had he not, in a measure, prepared us for it by publishing in 1877 his review of the works of Professor Haeckel, of Germany, and by the appearance of a number of able articles on philosophical subjects in the magazines.

The present work should seem to be the matured outcome of his meditations during many years' close observation of natural phenomena and of the laws of society. It is, in fact, an attempt to base society upon scientific principles, and to show not only that man has been developed in the same way as other forms of life, but that the laws of his being can be studied and utilized in the same way that the laws of nature below man have been learned and applied.

Mr. Ward's work is in a true sense a system of philosophy, but from this it must not be inferred that it is a bundle of abstruse speculations. It is eminently practical and is pervaded by a tone of serious concern for the future improvement of the race, which is strongly humanitarian. In fact, our author finds very much to be improved in society, and while he never exhibits acrimony nor deals in invective, he searches out and breaks with an authoritative hand the idols of the cave, the tribe, and the market place. He not only exposes the great popular errors of the time, but finds it necessary to grapple with the fallacies and sophistries that so largely characterize nearly all that passes for the most advanced thought as formulated by the foremost thinkers. Through these, with the sharp blade of clear, cold reason, he cleaves his way, fortifying every position gained by abundant proofs drawn fresh from nature.

Yet the work is by no means destructive. It destroys only the worthless, and in order to build a substantial structure in its place. All criticism of the present is in order to clear the ground for the future. Not content to point out the bad, it goes on to show what would be better and how it may be attained. The discussion is everywhere elevated far above the din and smoke of current partisanship, the ends aimed at are those of the remote future, not of the immediate present, and the reader rises from the perusal of the work with his mind clarified by the contemplation both of the insignificance of individual activities and of the grandeur of humanity as a whole.

That this book is destined to produce a profound impression upon the more thoughtful classes of society, and one that will grow with repeated and extended perusal, we cannot doubt. That such a system of thought should have emanated from an American is a most hopeful sign, and Washington is to be especially congratulated on being the focal centre from which it has proceeded.

148. [Notice of Dynamic Sociology]

History.—Written June 5, 1883.

The Capital, Washington, D. C., June 10, 1883, p. 4.

THIS book illustrates the difference between what is coming to be regarded as the essential character of a philosophy and the class of writing that formerly went by that name. The philosophy of all ages down to within a few decades was evolved entirely out of the inner consciousness of the writer, and consisted in the working over into a variety of novel forms of a certain number of abstract propositions which it was claimed must be true because all men accepted them. The modern philosopher does not attempt to write until he has first explored a large field of concrete facts, and his subsequent deductions are such and only such as are not only warranted but forced upon him by the perceived relations of such facts.

The present work is of this latter class, but the range of objects comprehended by it is so large that the scheme is well nigh a universal one. The author has laid broad foundations and built up a system which is a true cosmology. His preparation for this work has been most thorough, and the extent of his reading, as well as of his strictly scientific knowledge, is fully adequate to the task he has undertaken.

Mr. Ward's system of philosophy will suffer nothing in comparison with any of the more pretentious ones that have been brought forth on the other side of the Atlantic, such as that of Mr. Herbert Spencer. It differs from the otherwise quite similar scheme of Professor John Fiske in this country, who is an able disciple of Spencer, in not directly echoing the body of doctrine laid down by any other master. Indeed, when we have made this general comparison we have gone as far as the internal nature of the present work will justify, for while it postulates evolution and the entire body of truth, which is the product of modern science and the common property of all, it makes of this material an entirely different use from that made by any other work. Our author aims to take up philosophy where Spencer and Fiske have left it, and carry it a stage farther. But unfortunately this task, difficult in itself, is complicated by obstacles which one would least expect to meet with. These advanced writers themselves, imagining, as all men are prone to do, that they have all the truth there can ever be, have taken the pains to inculcate the plenitude of their scheme and virtually to deny that it is capable of being carried any farther.

This obstacle is especially strong in the department of social science, which forms the last and highest stage in all modern schemes of thought. The possibility of ever utilizing the forces of society, conceded as they are to be true natural forces, is more or less emphatically denied by the philosophers named, and the attempt of the present writer to point out how an applied social science can be established has required him to go to the very foundation of our existing social structure, to work out its genesis, and to formulate the laws of human nature and human action.

Notwithstanding the need for all this fundamental philosophic work, the writer never forgets that he is aiming at practical results, and not only scholars and statesmen, but business men, and the great toiling proletariat, will find that the plainest principles affecting their interest are clearly and fearlessly laid down. What these principles are as conceived by the author we cannot, of course, here explain, and must refer the reader to the book, in which we can assure him that he will find much which, either in its matter or its manner, will be novel and interesting.

We need scarcely add that the author of this comprehensive work is a citizen of Washington and a gentleman well known in scientific circles here.

149. [Note on the Preliminary Study of a Collection of Fossil Plants from the Lower Yellow-Stone]

History.—Written May 12, 1883 (see No. 158, infra, p. 275).

Science, Cambridge, Massachusetts, Vol. I, No. 19, June 15, 1883, p. 559.

MR. LESTER F. WARD has made a preliminary study of an interesting collection of fossil plants brought to the U. S. Geological Survey in 1882, by Dr. C. A. White, from the Laramie beds of the lower Yellowstone River. No less than thirty-four species are identified with those already described and figured, including many of those from Fort Union, described by Dr. Newberry, and a number from other localities in the West. A few, however, belong to species that have not heretofore been found within the territory of the United States (arctic or European). In addition to these, there was found a large number of forms which could not be identified, some of which are of peculiar interest. As Mr. Ward expects to visit these beds during the present season, and hopes to obtain more and better material, no descriptions of new species will be published until further study of these forms can be made.

150. [Science and the Use of Capitals]

History.—Written June 10, 1883.

The Republic, Washington, D. C., Vol. VII, No. 18, June 17, 1883, p. 279.

THE new scientific journal, *science*, has the most intense horror of capital letters—so much so that contributors complain bitterly that they are not allowed to express themselves clearly by the ordinary methods in which the best English writers sanction their use. Following the lead of certain pedantic bibliographers, it insists that the names of all books shall be in lower case, and extends this to include German titles in which, according to the genius of the language, all nouns take an initial capital. This is bad enough, but when it is carried to the absurd length of saying the *New York tribune*, the *New York evening post*, etc., it verges on the ridiculous. We presume that if *science* should deign to mention THE REPUBLIC it would speak of it simply as *the republic*, and so far the press is general. Now, I humbly suggest that while the editor of *science* may know a great deal about science, he does not understand the science of orthography. Capital letters are not mere rubrics with which to adorn the heads of chapters. Whatever may have been their original use, all modern languages employ them for a number of very definite purposes. In German they are largely grammatical signs denoting substantives, and *science* has no more right to disregard this use of them than it has to violate any other grammatical rule. I know not what god the editor of *science* may worship, but most civilized men think that their own particular one should be spelled with a capital. In English capitals are very frequently employed either to emphasize leading terms or to point out the special sense in which they are intended. They are especially used to designate *proper names*, and a book or a journal can have a proper name as well as a man or a pet dog. The fact that the word a journal may adopt as its name happens to exist also as a common noun does not prevent it from being a proper noun when used as such name. The distinction is one that every school-boy knows, and so we have to go to the scholarly editor of *science*, bred in the greatest institution of learning on the continent, to find one sufficiently obtuse not to perceive it. For the benefit of this learned personage I will inform him that a tribune is a different thing from a Tribune, that there is a plain distinction between a "solid substance placed firmly in an upright position" and a daily newspaper, and that an evening post would be an unusual kind of post. The editor of *science* may be so inflated as to imagine that his journal, instead of being merely a journal, is, in fact, the "real presence" of science itself, but I think I see a distinction. I certainly do not claim among the many virtues of THE REPUBLIC that it actually constitutes the republic under whose protection it is published. I might multiply illustrations, but I forbear. No. The English language is an institution which is somewhat stable. Defects it has, but I must be excused from smiling at the attempt of any one "organ," whether of science or anything else, to "reform" it down into a meaningless monotony incapable of expressing the great variety of refined distinctions which it has required so many centuries of differentiation in its words to render it capable of expressing.

151. [Notice of Dynamic Sociology]

History.—Written June 8, 1883.

The Evening Star, Washington, D. C., Vol. LXI, No. 9414, June 23, 1883, p. 2.

THIS work is a fundamental discussion of many of the most important questions of science and philosophy in their bearings upon social economy and human affairs in general. It does not treat directly these current questions in any department, and yet it furnishes the basis in science and in logic for the correct solution of nearly all of them. It is therefore, exceedingly opportune, as there has never been a period in which greater activity existed in the direction of thoroughly working out and scientifically settling the problems of social, national and individual life. While this book bears clearly and boldly upon questions of religious liberty, of the rights and duties of the sexes, and of political economy in its broadest sense, it bears more especially upon three of the great national questions which are just now pressing for solution in this country, and which must enter largely into the coming political campaign. The first of these is the question of regulating foreign trade—the tariff question. The second is that of regulating internal transportation—the monopoly question. The third is the question of public education. Those who intend to take part in any of these discussions cannot afford to be ignorant of what the author of this work says. They need not, however, expect to find their pet hobbies passionately defended. The writer is no partisan. Scarcely do any of the popular shibboleths, such as "protection," "free trade," "anti-monopoly," etc., occur in the work. It deals constantly with the deeper laws of society, and aims to furnish a true science of politics, about which men will no more dispute than they now do about the science of chemistry. And if the author seems at times to take strong grounds on one side or the other of any of these discussions, it is because he perceives that the opposite side has failed to grasp some fundamental truth of nature and is being led astray by ignorance or error. The careful study of this work by candid inquirers into our social and national polity, cannot fail to impart a sober and healthful tone to public discussion. We therefore welcome it on the eve of a great national campaign, not only as a work which is calculated to allay animosity, but also as one tending to secure in no small degree the agreement of all parties upon some of the most vexed questions of the times.

Mr. Ward has for many years been a resident of Washington, and we are glad to see that he has improved the opportunities thus afforded for making so thorough a study of national and social affairs as presented here at the political center of the country.

152. [Note on Gray and Trumbull's Review of de Candolle's Origine des Plantes Cultivées]

History—Written May 12, 1883.

Science, Cambridge, Massachusetts, Vol. I, No. 21, June 29, 1883, p. 616.

DE CANDOLLE'S "Origine des plantes cultivées" has received a searching review at the hands of Professor Asa Gray and Mr. J. Hammond Trumbull in the *American Journal of Science*. The book itself is as valuable to anthropology as it is to botany, and it was fitting that a competent representative of each of these sciences should be associated in its examination. The reviewers, however, in this case, seem to have had a definite object ulterior to that of merely appreciating this last great contribution of the venerable phytologist. The claims of America as the original source of a large number of the best known vegetable products of the globe required to be defended; and they deliberately assumed and performed this task, showing in a large number of cases that de Candolle had either ignored or had not duly weighed the evidence that exists in favor of their American origin. The comprehensive and critical learning displayed in these articles, relative to the mention of these plants in the early history of American discovery, is only equalled by the shrewdness and force with which it is marshalled in support of the views which the writers feel called upon to set forth and sustain.

153. On the Position of the Gamopetalæ—Abstract

History—This is the abstract, written Aug. 15–17, 1882, of quite an elaborate paper that I had prepared from Aug. 1–15, and presented to the Biological Section of the American Association for the Advancement of Science at the Montreal meeting, on Aug. 28th.

Proceedings of the American Association for the Advancement of Science, Vol. XXXI, Montreal Meeting, Salem Press, July, 1883, pp. 460–462.

IN 1789, Laurent de Jussieu, in his "Genera Plantarum," established the three "Divisions" of Dicotyledons, assigning the Apetalous Division the lowest place, the Monopetalous Division the second, or intermediate place, and the Polypetalous Division the highest place in the series.

In 1848, Adrien de Jussieu, in his "Cours Elémentaire
de [Botanique," reversed the order of the second and
461 third of these Divisions and gave his reasons therefor.
Notwithstanding this, nearly all subsequent authors have steadily adhered to the order established by Laurent de Jussieu, which is supposed to have been that of his uncle Bernard, the real founder of the "natural system."

This arrangement has, however, been severely criticised by Al. Braun and many others.

The present paper is designed to supplement an article "On the Natural Succession of the Dicotyledons" communicated by the writer to the "American Naturalist" for November, 1878, and to bring forward some evidence from statistics and from palæontology, as that did from organogeny, of the comparative *recency* of those plants having tubular, bell-shaped, or otherwise consolidated corollas, and thus to claim for that Division of the Dicotyledons—the *Monopetalæ*, or *Gamopetalæ*, as they are now more properly called—the highest place in the series, as did the younger Jussieu.

This is shown, first, by the great extent to which these plants are herbaceous as compared with those having the petals free (*Polypetalæ*) or with those destitute of petals (*Apetalæ*, or *Monochlamydeæ*).

From a comparison of seventeen floras, including those of the Eastern United States, of California, of Great Britain, of Italy, of the West Indies, etc., it is found that of the total Dicotyledons the Apetalous Division furnishes on an average 13.3 per cent, the Polypetalous Division 43.3 per cent, and the Gamopetalous Division 43.4 per cent; but when the shrubs, trees, and woody vines of each of these Divisions are alone considered, we find that the *Apetalæ* furnish about 24 per cent, the *Polypetalæ* over 43 per cent., and the *Gamopetalæ* only about 33 per cent. In some of the floras compared the percentage of this last Division is as low as 20.

A perhaps still more striking way of showing this is to see what proportion the *woody plants* of each Division bear to the total number in that Division; *e. g.*, of the *Apetalæ*, which in the flora of the Eastern United States form only 13 per cent of the total Dicotyledons, 42 per cent are woody, while of the *Gamopetalæ*, which form 47 per cent of the Dicotyledons, only 16 per cent are woody.

If trees only are taken into the account the contrast
462 becomes | still stronger. In the last named flora, which is the largest of those compared, the *Apetalæ* constitute 38, the *Polypetalæ* 45, and the *Gamopetalæ* 17 per cent of the dicotyledonous trees.

These facts seem to show that the *Gamopetalæ* constitute a comparatively late type of vegetable growth which has not yet had time, as it were, to perfect itself and assume the frutescent and arborescent forms which mark the highest development, or phytological maturity.

In the second place, and in order to anticipate the possible objection that this might equally prove degeneracy, such as is seen in the Monocotyledons and in the Cryptogams, which, though known to be older types of vegetation, are, nevertheless, at the present time chiefly herbaceous, although once probably for the most part arborescent, the following palæontological evidence was adduced:

It was shown

1. That the first appearance of plants that are clearly referable to Gamopetalous genera is much later than that of either Apetalous or Polypetalous plants.

2. That the most abundant of those genera are such as in the living flora have very deeply lobed corollas, as in *Viburnum*, thus approaching the dialypetalous condition and strongly suggesting that at the time of their appearance they might not have been truly gamopetalous at all.

3. That the relative paucity of gamopetalous species is much more marked in fossil than in living floras.

4. That the lower the horizon, the greater the disproportion in this respect.

5. That in all collections the number of *specimens* of fossil is less than of living *Gamopetalæ* in proportion to the number of species; *i. e.*, there were then not only less numerous forms, but those that existed were less abundant.

These several propositions were supported by copious citations and by tabular exhibits compiled from Schimper's "Paléontologie Végétale," Heer's "Flora tertiaria Helvetiæ," Lesquereux's "Cretaceous and Tertiary Floras of the United States," and other works, as well as by data obtained from the collections of fossil plants at the United States National Museum.

154. The Organic Compounds in Their Relations to Life.[1]—Abstract

History.—This abstract was written Aug. 22–23, 1882. The full history of the paper is given in connection with the paper itself (see No. 136, supra, p. 97).

Ibid., pp. 493–494.

ORGANIC compounds may be defined as "substances whose highly complex and very unstable molecules are composed of those of inorganic compounds or of organic compounds of lower organization, formed on the cooled surfaces of fully developed planets at life-supporting temperatures."

So far as the cosmical origin of the various substances composing the earth's crust, whether elemental or compound, is understood, it seems to have conformed to the following law: the molecules constituting each progressively more complex unit exhibit *increase of mass* accompanied by *decrease of stability*.

The artificial synthesis of organic compounds has obliterated the line formerly supposed to exist between the chemical constitution of inorganic and of organic compounds.

[1] This paper was published in full in the *American Naturalist*, Vol. XVI (December, 1882), pp. 968–979.

The properties of substances depend upon their molecular constitution: the more complex their constitution the more active their properties. Thus the properties of compounds are as a rule more active than those of elements, those of organic are more active than those of inorganic compounds, those of the alkaloids more active than those of the amyloids, and those of the albuminoids more active than those of the alkaloids. In the last case, however, the activity manifests itself in a different manner, viz., through rapid changes of internal structure including the
phe|nomena of isomerism; thus partially ceasing to be 494
molecular and in a certain way affecting the mass.

These nitrogenous compounds themselves possess grades of complexity and instability, and thus we arrive in an ascending series at proteine and finally at protoplasm.

Protoplasm is a chemical substance whose relatively large molecules may have been compounded of those of the less complex albuminoids.

The activities manifested by protoplasm consist in actual alterations in the mass of the substance, which is the fundamental fact involved in the phenomena of life. Life is therefore essentially a property of protoplasm.

All the higher manifestations of life are reducible to protoplasmic activity, and the enlarged scale on which they operate is due to subsequent *organization*. A living being is only a quantity of organized protoplasm, and tissues are merely the framework and material machinery by means of which the life-substance is enabled to multiply effects.

155. Classification of Organisms[1]

History.—The proofs of that part of *Dynamic Sociology* had just reached me, and I took them to Montreal with me and read from them, and then prepared this abstract. The paper was read August 29, 1882.

Ibid., pp. 494-495.

THE terms *animal* and *vegetable* have proved wholly inadequate to express the distinctions which are found to exist among organisms. As popular terms they are useful, but as scientific terms they have already led to much fruitless discussion.

The fundamental distinction in biology should be drawn between those organisms which are capable of assimilating chemical or inorganic matter, and those which depend entirely upon the appropriation of matter already so manufactured. We would thus have two classes of organisms, viz., first, assimilators, tissue manufacturers, or ***autogens;*** and second, *parasites*.

The first of these classes might be subdivided into three

[1] This paper was condensed from the writer's work *Dynamic Sociology* (New York, D. Appleton & Co., 1883, Vol. i, pp. 347-355), published since the Montreal Meeting.

groups: 1. Those that manufacture protoplasm only and con|sist entirely of that substance. 2. Those that manufacture both protoplasm and also some form of 495
protective integument or framework. 3. Those which decompose carbonic dioxide and employ the carbon thus liberated as the strengthening material of their tissues, viz., plants proper.

The second class is also divisible into three groups: 1. Those which appropriate matters already manufactured by organisms of the first class (or, as in the case of lichens, take them at third hand from organisms of the same class), but which are not only fixed like plants but are of low organization and simple cellular structure. 2. True parasitic plants, whose organization plainly indicates that they have descended from chlorophyl-bearing plants, of which they are degraded types. 3. Animals proper, which live on the substance manufactured by the first class of organisms, either by taking it directly from plants, or by preying on others of their own group which have derived their sustenance from plants.

156. [Review of Chapters XI–XIV of Dynamic Sociology]

History.—Major Powell reviewed the book at great length in *Science*, devoting four articles to it in as many numbers of that journal (see supra, pp. 214–215). The first of these articles was a general review of the whole work, the other three dealing with certain special aspects. In writing the first article he asked me to assist him, and to review Chapters XI–XIV, which I did on June 12, 1883. I had written so many notices of the book that it was little effort to write them. Major Powell gave me a stenographer, and I quickly dictated a summary of those chapters.

Science, Cambridge, Massachusetts, Vol. II, No. 23, July 13, 1883, pp. 47–49.

CHAPTER XI is entitled "Action,"—a term chosen in preference to the more common expression, *conduct*. The chapter is chiefly devoted to the discussion of a systematic classification of actions, first, as involuntary and voluntary; and voluntary actions are again divided into impulsive or sensori-motor, and deliberative or ideo-motor. Each of the latter classes consists of two groups; namely, actions possessing moral quality, and actions devoid of moral quality.

It is no part of the author's purpose to treat of actions possessing moral quality; although, in order to make clear the irrelevancy of such actions to his discussion, he occupies some space in going over the ground usually covered by writers on ethics. Actions devoid of moral quality are those upon which progress essentially depends, and chiefly that branch which falls under the more general head of deliberative or ideo-motor actions. They are further subdivided into static and dynamic, the former group embracing the great bulk of human activities in the performance of the ordinary duties of life. Static actions of this class do not result in progress, but tend simply to preserve the existing social status. Dynamic actions constitute the really progressive class of actions.

The chief fact which distinguishes dynamic actions from all others is, that they are performed by the indirect or inventive method. All the progress that has taken place in society has been due to such actions. However spontaneous such progress may appear, it has, nevertheless, been the result of teleologic methods in adjusting natural phenomena in such a manner that they will accomplish desired ends, remote in themselves, but foreseen by the intelligence of the developing intellect. The results are the essential elements of human | art; and consequently civilization
is fundamentally and wholly artificial. Here Mr. 48
Ward introduces a series of illustrations of typical dynamic actions performed in the course of social progress, for the purpose of elucidating the central idea which he desires to embody in the term "dynamic action."

Chapter xii is a discussion of opinion as the direct means to progressive action. As dynamic actions are ideo-motor, such actions must result from the possession by the agent of certain underlying and directing ideas. The truism that "ideas rule the world" simply means, that opinions determine actions. But in order to produce dynamic actions—that is, actions which will, in fact, result in progress—it is essential that the opinions which underlie them be in rigid harmony with objective reality. Dynamic action can only flow from correct opinion.

Opinions must not only be correct, they must be important. Unless important, no appreciable dynamic result will flow therefrom. The most important opinions, or ideas, are arranged under four general heads: first, cosmologic ideas; second, biologic ideas; third, anthropologic deas; fourth, sociologic ideas. Correct ideas belonging to these four great classes constitute the primary motive power to all human progress.

Chapter xiii is upon knowledge—the immediate data of ideas. Opinions cannot be directly reached. They are not subject to the will, either of the party holding them or of any other: they are simply consequents. Obviously, the antecedents of ideas consist in the data possessed by the mind relative to the materials and phenomena of nature. Such data are grouped by the author under the general term "knowledge." Knowledge, therefore, must first exist; and, if it exist, no effort need be expended in determining opinion. In this chapter the author shows that the chasm which in fact separates the intelligence of the lowest and the highest classes of mankind is chiefly due to inequality in the possession of the data for thought. He shows that the capacity of the mind is, in any particular class of society, practically equal; that, even in what are known as semi-civilized or barbaric races, the capacity exists for a far greater amount of knowledge than is ever obtained.

Chapter xiv is on education as the direct means to knowledge. The possession of knowledge, therefore, if it could be secured, would constitute the true means to the proximate end, and thus secure the ultimate purpose. But
49 the human mind is so constituted that it | cannot be
safely intrusted to secure this end for itself; for the
individual cannot understand the necessity for this know-

ledge, or guide himself wisely in its attainment, prior to its acquisition: that is, the period of acquisition is in the earlier years of the life of the individual, when he must be guided by others. The initial means in the entire series is therefore education, actively considered as a function of society.

The work closes with a condensed but fundamental treatment of the general subject of popular education, in which appears a review of the various theories that have been held, and that still control human action on this subject. He divides the general body of public opinion into five parts, which he denominates "the five kinds of education." These are: first, education of experience; second, of discipline; third, of culture; fourth, of research; fifth, of information. The first four of these kinds of education are considered for the purpose of showing, that, however important in themselves, they are insufficient to accomplish the great end of securing an artificial civilization as the product of direct social action. The last of these forms of education, therefore, is the only one which embodies such promise.

The author sees little hope in the imperfect and desultory attempts of individuals to secure this great need in society. To render it of any value, he claims that education must be the systematic work of society in its organized capacity. Ceasing to exert itself longer in vain attempts to secure directly the various proximate ends, society should vigorously adopt this initial means, and concentrate its energies on the work which is clearly practicable—that of furnishing to all its members the data actually in its possession.

Under the heading "Matter of education" the author briefly, but without dogmatism, discusses the general theorem that the subject-matter should be a knowledge of nature—a knowledge of the environment of the individual and of mankind. His treatment of the methods of popular instruction is brief, maintaining that this is merely a matter of supply in the politico-economic sense, which will certainly come as soon as there shall be an adequate demand.

He says, "The methods and the teachers have always been as good as the popular notions of education, and they will doubtless continue to be so." The only criterion which he does lay down with regard to method is that it be teleologic. He insists that education, like every other department of civilization, must be an artificial product; that it must be undertaken deliberately, planned by human intelligence, and achieved through human effort.

The author discusses, in a broad and philosophic manner, a great body of questions in which civilized man is deeply interested. He has therefore written for a wide reading; and happily his style, in its essential characteristics, will not repel those to whom it is presented.

157. Marsh and Aquatic Plants of the Northern United States, Many of Which are Suitable for Carp Ponds

History.—This paper was prepared at Professor Baird's request May 23 to June 19, 1882, chiefly by checking off the species in Mann's Catalogue and turning it over to Mrs. Ward to copy.

Bulletin of the United States Fish Commission, Vol. III, No. 17, Washington, D. C., Sept. 6, 1883, pp. 257–265.

THE species indicated by the heavy-faced type are strictly aquatic. Those which are especially recommended by Dr. Hessel for carp ponds are Nos. 7, 8, 18, 19, 20, 21, 22, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 67, 81, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114. Those which occur near Washington are numbers 2, 4, 6, 7, 9, 11, 13, 14, 15, 16, 17, 23, 25, 26, 27, 29, 31, 32, 35, 36, 38, 40, 41, 51, 58, 60, 61, 63, 65, 66, 68, 69, 72, 73, 74, 75, 76, 77, 78, 80, 81, 82, 83, 84, 85, 86, 89, 95, 96, 97, 100, 104, 105, 106, 116, 121, 123, 125, 128, 129, 131, 133, 134, 135, 136, 138, 143, 145, 147, 151, 154, 155, 157, 158, 160, 161, 162, 166, 168, 171, 174, 178, 180.

RANUNCULACEÆ.

Crowfoot Family.

1. *Ranunculus hederaceus*, L. Introduced near Hampton, Va.
2. *Ranunculus ambigens*, Watson. [*R. alismæfolius*, Geyer.] Water-Plantain Spearwort. Eastern Branch marsh, D. C.; also marsh near the mouth of Hunting Creek, Va.
3. *Ranunculus flammula*, L. Smaller Spearwort. Shore of Lake Ontario and northward.
4. *Ranunculus pusillus*, Poir. Small Spearwort. Potomac Flats above Eads' Mill, D. C.
5. *Ranunculus cymbalaria*, Pursh. Seaside Crowfoot. Sandy shores from New Jersey northward, and along the great lakes to Illinois and westward.
6. *Ranunculus sceleratus*, L. Cursed Crowfoot. Common everywhere.

NYMPHÆACEÆ.

Water-Lily Family.

7. **Brasenia peltata,** Pursh. Water-Shield. Carberry-Meadows below Eads' Mill, D. C.
8. **Nelumbium luteum,** Willd. Yellow Nelumbo, or Water Chinquepin. Waters of the Western and Southern States; rare in the Middle States; introduced into the Delaware below Philadelphia. Near Woodstown and Sussex County, New Jersey. Big Sodus Bay, Lake Ontario, and in the Connecticut near Lyme.

| 9. **Nuphar advena*, Ait. Yellow Pond-Lily. Spatter
258 Dock. Common everywhere.

10. * *Nuphar sagittæfolium*, Pursh. North Carolina and southward.

* Pronounced injurious to carp ponds by Dr. Hessel.

CRUCIFERÆ.

Mustard Family.

11. *Cardamine rhomboidea*, DC. Spring-Cress. Common.
12. *Cardamine rotundifolia*, Michx. Mountain Water-Cress. Pennsylvania, and southward along the mountains.
13. *Cardamine hirsuta*, L. Bitter Cress. Common.

HYPERICACEÆ.

St. John's-wort Family.

14. *Elodes Virginica*, Nutt. Marsh St. John's-wort. Common.

LEGUMINOSÆ.

Pulse Family.

15. *Lathyrus palustris*, L. Marsh Vetchling. New England to Pennsylvania, Illinois, and northward.

CRASSULACEÆ.

Orpine Family.

16. *Penthorum sedoides*, L. Ditch Stone-crop. Common everywhere.

HALORAGEÆ.

Water-Milfoil Family.

17. **Myriophyllum spicatum**, L. Water-Milfoil. Below Alexandria, Va.
18. **Myriophyllum verticillatum**, L. Common.
19. **Myriophyllum heterophyllum**, Michx. Lakes and rivers, from Northern New York, westward and southward.

20. **Myriophyllum scabratum,** Michx. From Southern New England and Ohio, southward.
21. **Myriophyllum ambiguum,** Nutt. Massachusetts to New Jersey, Pennsylvania and southward, near the coast.
22. **Myriophyllum tenellum,** Bigelow. Northern New York, New England, and northward.
23. **Proserpinaca palustris,** L. Mermaid-weed. Not rare.
24. **Proserpinaca pectinacea,** Lam. Swamps near the coast.

| ONAGRACEÆ.

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EVENING PRIMROSE FAMILY.

25. *Jussiæa decurrens*, DC. Virginia to Illinois and southward.
26. *Ludwigia palustris*, Ell. Water Purslane. Common; also in Europe.

LYTHRACEÆ.

LOOSESTRIFE FAMILY.

27. *Ammannia humilis*, Michx. Tooth-cup. Massachusetts to Michigan, Illinois, and southward. Flats of Potomac, D. C.
28. *Ammannia latifolia*, L. Ohio, Illinois, and southward.
29. *Nesæa verticillata*, H. B. K. Swamp Loosestrife. Flats of Potomac.

UMBELLIFERÆ.

PARSLEY FAMILY.

30. *Hydrocotyle repanda*, Pers. Water Pennywort. Maryland and southward.

31. *Hydrocotyle ranunculoides*, L. Shores of Potomac, Maryland.
32. *Hydrocotyle Americana*, L. Common, northward.
33. *Hydrocotyle umbellata*, L. Massachusetts, on the coast to Pennsylvania.
34. *Hydrocotyle interrupta*, Muhl. Massachusetts to Virginia and southward along the coast.
35. *Eryngium Virginianum*, Lam. Eryngo. Button Snakeroot. New Jersey and southward.
36. *Discopleura capillacea*, DC. Mock Bishop-weed. Massachusetts to Virginia, and southward. Near Custis Spring, Va.
37. *Cicuta bulbifera*, L. Water-Hemlock. Common, northward.
38. *Sium cicutæfolium*, Gmel. Water-Parsnip. Common.
39. *Sium angustifolium*, L. Massachusetts, Michigan, Illinois, westward. Europe.

COMPOSITÆ.

Composite Family.

40. *Bidens cernua*, L. Smaller Bur-Marigold. Virginia to Wisconsin and southward.
41. *Bidens chrysanthemoides*, Michx. Larger Bur-Marigold. Common.
42. ***Bidens Beckii**, Torr. Water Marigold. Massachusetts to New Jersey, Illinois, and northward.

LOBELIACEÆ.

Lobelia Family.

43. **Lobelia paludosa**, Nutt. Delaware and southward.
44. **Lobelia Dortmanna**, L. Water Lobelia. Northern Pennsylvania to New England.

* Pronounced injurious to carp ponds by Dr. Hessel.

LENTIBULACEÆ.

Bladderwort Family.

45. **Utricularia inflata,** Walt. Inflated Bladderwort. Maine to Virginia and southward.
46. **Utricularia minor,** L. Smaller Bladderwort. Rhode Island to Illinois and northward.
47. **Utricularia clandestina,** Nutt. Eastern New England, Western New York, and New Jersey.
48. **Utricularia intermedia,** Hayne. New England and New Jersey to Ohio, Wisconsin, and northward.
49. **Utricularia striata,** Le Conte. Long Island, New Jersey, and southward.
50. **Utricularia biflora,** Lam. Illinois and southward.
51. **Utricularia gibba,** L. Virginia to Massachusetts, Northern New York and Northern Illinois.
52. **Utricularia purpurea,** Walt. Maine to Virginia and southward.
53. **Utricularia resupinata,** Greene. Eastern Maine to Rhode Island.
54. **Utricularia cornuta,** Michx. Common.
55. **Utricularia subulata,** L. New Jersey, Virginia and southward.

SCROPHULARIACEÆ.

Figwort Family.

56. *Herpestis rotundifolia*, Pursh. Illinois and southward.
57. *Herpestis amplexicaulis*, Pursh. New Jersey and southward.
58. *Gratiola Virginiana*, L. Hedge-Hyssop. Common.
59. *Gratiola sphærocarpa*, Ell. New Jersey to Illinois and southward.
60. *Ilysanthes gratioloides*, Benth. False Pimpernel. Common.

61. **Micranthemum Nuttallii,** Gray. Banks of the Delaware River and southward.
62. *Limosella aquatica*, L., var. *tenuifolia* Hoffm. From New Jersey northward.
63. *Gerardia purpurea*, L. Purple Gerardia. Maine to Wisconsin and southward.

LABIATÆ.

Mint Family.

64. *Mentha rotundifolia*, L. Round-leaved Mint. Maine, New Jersey, and Pennsylvania.
65. *Mentha viridis*, L. Spearmint. Common (natural from Europe).
66. *Mentha piperita*, L. Common (natural from Europe).
67. **Mentha aquatica,** L. Water Mint. Delaware.
68. *Lycopus Virginicus*, L. Bugle-weed. Common, especially northward.
69. *Physotegia Virginiana*, Benth. False Dragonhead. Western New York to Wisconsin and southward. Rocks, Potomac shore.

GENTIANACEÆ.

Gentian Family.

70. **Limnanthemum lacunosum,** Griesbach. From Maine and New York to Virginia and southward.
71. **Limnanthemum trachyspermum,** Gray. Floating Heart. Maryland and southward.

POLYGONACEÆ.

Buckwheat Family.

72. *Polygonum arifolium*, L. Halberd-leaved Tear-thumb.

73. *Polygonum hydropiperoides*, Michx. Mild Water-pepper.
74. *Polygonum sagittatum*, L. Arrow-leaved Tear-thumb. Common.

PIPERACEÆ.

75. *Saururus*, L. Lizard's-tail. Common.

URTICACEÆ.

Nettle Family.

76. *Pilea pumila*, Gray. Richweed; Clearweed.
77. *Bœhmeria cylindrica*, Willd. False Nettle. Common.

ARACEÆ.

Arum Family.

78. *Peltandra Virginica*, Raf. Arrow Arum. Common.
79. *Calla palustris*, L. Water Arum. New England to Pennsylvania, Wisconsin, and common northward.
80. *Orontium aquaticum*, L. Golden-Club. Massachusetts to Virginia, and southward.

LEMNACEÆ.

Duck-weed Family.

81. **Lemna polyrrhiza**, L. Duck-weed; Duck's Meat.

TYPHACEÆ.

Cat-tail Family.

82. *Typha latifolia*, L. Common Cat-tail; Reed-mace. Common.
83. *Typha angustifolia*, L. Small Cat-tail; Narrow-leaved Cat-tail. (Europe.)

84. *Sparganium eurycarpum*, Eng. Bur-reed. New England and Pennsylvania, northward and westward.
85. *Sparganium simplex*, Hudson. New England and northward. (Europe.)

NAIADACEÆ.

Pondweed Family.

86. **Naias flexilis,** Rostk. Naiad. Common. (Europe.)
87. **Zannichellia palustris,** Micheli. Horned Pondweed. Rather rare. (Europe.)
88. **Potamogeton amplifolius,** Tuckerman. Pondweed. Not rare.
89. **Potamogeton Claytonii,** Tuckerman. Common.
90. **Potamogeton compressus,** L. Not common.
91. **Potamogeton crispus,** L. Delaware, Pennsylvania, and New Jersey.
92. **Potamogeton gramineus,** L. The commonest form. (Europe.)
93. **Potamogeton gramineus,** L., var. **spathulæformis.**
94. **Potamogeton gramineus,** L., var. **myriophyllus,** R.
95. **Potamogeton hybridus,** Michx.
96. **Potamogeton lonchites,** Tuckerman. New England to Illinois.
97. **Potamogeton lucens,** L. Not common. In the Potomac.
98. **Potamogeton lucens,** L., var. minor, Nolte.
99. **Potamogeton lucens,** L., var. **Connecticutensis.**
100. **Potamogeton natans,** L. Common. (Europe.)
101. **Potamogeton Niagarensis,** Tuck. Rapids above Niagara Falls.
102. **Potamogeton Oakesianus,** Robbins. Not rare in Eastern Massachusetts.
103. **Potamogeton obtusifolius,** Mertens & Koch. Very rare. Pennsylvania and Michigan.

104. **Potamogeton pauciflorus,** Pursh. Common.
105. **Potamogeton pectinatus,** L. Common.
106. **Potamogeton perfoliatus,** L. Common.
107. **Potamogeton prælongus,** Wulfen. East New England and along the Great Lakes to Lake Superior.
108. **Potamogeton pulcher,** Tuckerman. Eastern Massachusetts, Missouri, Georgia.
109. **Potamogeton pusillus,** L. Very common, especially southward.
110. **Potamogeton Robbinsii,** Oakes. New England, New York, Pennsylvania, and Ohio.
111. **Potamogeton rufescens,** Schrad. New England to Pennsylvania, Illinois, and especially northward.
112. **Potamogeton spirillus,** Tuckerman. Maine to Lake Superior and Virginia.
113. **Potamogeton Tuckermani,** Robbins. White Mountains, New Hampshire, to Pennsylvania.
114. **Potamogeton Vaseyi,** Robbins. Illinois, Massachusetts.

ALISMACEÆ.

WATER-PLANTAIN FAMILY.

115. *Scheuchzeria palustris*, L. New England to Pennsylvania, Illinois, and northward.
116. *Alisma plantago*, L., var. Americanum, Gray.
117. *Echinodorus parvulus*, Engelm. Massachusetts and Michigan to Illinois.
118. *Echinodorus rostratus*, Engelm. Illinois and southward.
119. *Echinodorus radicans*, Engelm. Illinois and southward.
120. *Sagittaria lancifolia*, L. Arrowhead. Virginia, and southward to the West Indies.
121. *Sagittaria variabilis*, Engelm. New Jersey and southward.

122. *Sagittaria calcyna*, Engelm. Maine to Delaware, Wisconsin, and southward.
123. *Sagittaria heterophylla*, Pursh.
124. *Sagittaria graminea*, Michx. Rather common, especially southward.
125. *Sagittaria pusilla*, Nutt. From Eastern New Jersey and Philadelphia southward, near the coast.
126. **Sagittaria natans,** Michx.

HYDROCHARIDACEÆ.

Frog's-bit Family.

127. **Limnobium Spongia,** Richard. American frog's-bit. Lake Ontario, Illinois, and in the Southern States.

PONTEDERIACEÆ.

Pickerel-weed Family.

128. **Pontederia cordata,** L. Pickerel-weed. Common.
129. *Heteranthera reniformis*, Ruiz. and Pav. Mud Plantain.
130. *Heteranthera limosa*, Vahl. West Virginia to Illinois and southward.

XYRIDACEÆ.

Yellow-eyed Grass Family.

131. *Xyris flexuosa*, Muhl. Yellow-eyed Grass. Eastern Massachusetts southward near the coast; also Illinois, Wisconsin, and Michigan.
132. *Xyris Caroliniana*, Walt. Rhode Island to Virginia and southward.

CYPERACEÆ.

Sedge Family.

133. *Cyperus phymatodes*, Muhl. Vermont to Wisconsin, and common southward.

134. *Cyperus virens*, Michx. Virginia and southward.
135. *Dulichium spathaceum*, Pers. Common.
136. *Fuirena squarrosa*, Michx. Massachusetts to Virginia and southward; also Michigan.
137. *Eleocharis acicularis*, R. Br. Common. (Europe.)
138. *Eleocharis compressa*, Sullivant. Northern New York to Ohio and Illinois.
139. *Eleocharis equisetoides*, Torr. Rhode Island, Michigan, Delaware, and southward.
140. *Eleocharis intermedia*, Schultes. New York and Pennsylvania to Illinois and northward.
141. *Eleocharis melanocarpa*, Torr. Massachusetts to Virginia, and southward.
142. *Eleocharis microcarpa*, Torr. New Jersey and southward.
143. *Eleocharis obtusa*, Schultes. Most common.
144. *Eleocharis olivacea*, Torr. Massachusetts to New Jersey; also shore of Lake Ontario.
145. *Eleocharis palustris*, R. Br. Very common.
146. *Eleocharis pygmæa*, Torr.
147. *Eleocharis quadrangulata*, R. Br. New York, Michigan, and southward.
148. *Eleocharis Robbinsii*, Oakes. New Hampshire to New Jersey and southward.
149. *Eleocharis rostellata*, Torr. Rhode Island, East Massachusetts, and Vermont to New Jersey, Virginia, Michigan, and southward.
150. *Eleocharis simplex*, Torr. Eastern shore of Maryland and southward.
151. *Eleocharis tenuis*, Schultes. Common.
152. *Scirpus Canbyi*, Gray. Maryland.
153. *Scirpus cæspitosus*, L. New York and Northern Illinois.
154. *Scirpus debilis*, Pursh. Massachusetts to Virginia and southward.
155. *Scirpus fluviatilis*, Gray. Club-rush. Western Vermont to Pennsylvania, Wisconsin, and Illinois.

156. *Scirpus maritimus*, L. Common on the coast and near salt springs in the interior of New York.
157. *Scirpus eriophorum*, Michx. Wool-grass. Clump-head Grass.
158. *Scirpus lineatus*, Michx.
159. *Scirpus Olneyi*, Gray. Rhode Island to Delaware and southward.
160. *Scirpus atrovirens*, Muhl.
161. *Scirpus polyphyllus*, Vahl. West, New England to Illinois, and common southward.
162. *Scirpus pungens*, Vahl. Very common. (Europe.)
163. *Scirpus Smithii*. Wet shores, Lake Ontario to Illinois and Delaware Bay.
164. *Scirpus subterminalis*, Torr. New Jersey and New England to Michigan and westward.
165. *Scirpus supinus*, L. var. *Hallii*. Illinois and south-westward.
166. *Scirpus sylvaticus*, L. Eastern Massachusetts, New York.
167. *Scirpus Torreyi*, Olney. New England to Pennsylvania and Michigan.
168. *Scirpus validus*, Vahl. Great Bulrush. Common everywhere.
169. *Eriophorum alpinum*, L. Cotton Grass. New England to Pennsylvania, Wisconsin and northward.
170. *Eriophorum vaginatum*, L. New England to Pennsylvania, Wisconsin and northward.
171. *Eriophorum Virginicum*, L. Common.
172. *Eriophorum polystachyon*, L. Common northward.
173. *Eriophorum gracile*, Koch. New England to Illinois and northward.
174. *Rhynchospora, alba*, Vahl. Beak-Rush. (Europe.)
175. *Rhynchospora macrostachya*, Torr. Massachusetts, Rhode Island, New Jersey, and southward.
176. *Rhynchospora scirpoides*, Gray. Rhode Island, Massachusetts.
177. *Carex aquatilis*, Wahl. New England to Wisconsin.

178. *Carex riparia*, Curtis. (Europe.)
179. *Carex trichocarpa*, Muhl. (Common.)

GRAMINEÆ.

Grass Family.

180. *Eragrostis reptans*, Nees. Common.
181. *Arundinaria tecta*, Muhl. Small Cane. Virginia, Illinois, and southward.

Washington, D. C., *June* 20, 1882.

158. [Note on a Collection of Plants from the Fort Union Group]

History.—Written October 1, 1883 (see No. 149, supra, p. 241).

Science, Cambridge, Massachusetts, Vol. II, No. 36, October 12, 1883, p. 517.

A LARGE and exceptionally fine collection of fossil plants from the Fort-Union group (Laramie) is now on its way to Washington, collected in the valley of the Yellowstone River, within thirty miles of Glendive, Montana, by Mr. Lester F. Ward, assisted by Mr. Richard Foster. Mention has already been made (SCIENCE, i. 559) of a small but interesting collection from this locality, which was partially elaborated last spring. The same stations were revisited and thoroughly worked. The expedition was very successful, and the collection is one of the largest and best ever made in the country. Fifty-seven boxes of fossils, aggregating nearly four tons in gross weight, were obtained. The material was carefully assorted, and scarcely any but cabinet specimens were taken. In the very large number of genera and species represented, there can scarcely fail to be some new to science. The localities examined embrace several distinct horizons within the group, each possessing a special facies. Nearly all the old forms described by Dr. Newberry appear in abundance,—Populus, Platanus, Viburnum, Rhamnites, Tilia, etc.—but varied by additional species; while such new genera as Trapa, Rhamnus, Ilex, Elæodendron, Asarum, Ficus, etc., are present, often in great profusion, and beautifully preserved. Special pains were taken to secure as large and complete a representation as possible of those forms whose affinities are less obvious or wholly unknown. Mr. Ward intends to commence work on this collection as soon as it arrives.

159. [Note on a Geological Excursion down the Missouri River]

History.—Written October 1, 1883.

Ibid., pp. 517–518.

A NOTABLE event of the present season's field- | work has been the descent of the Missouri River in a "Mackinaw" (a sort of flatboat) from Fort Benton to Bismarck by a party of geologists, consist-
518 ing of Dr. C. A. White, Mr. J. B. Marcon, and Mr. Lester F. Ward, with one assistant, for the express purpose of geological and paleontological study.

The distance, according to steamboat schedule, is 1059 miles; and thirty days (Aug. 22d to Sept. 20th) were consumed in the journey. A large part of the territory passed through is occupied by Indian reservations, and there is no white population between Benton and Poplar Creek Agency, the first post-office—a distance of 567 miles. The river is very low at this season of the year; and the current was correspondingly sluggish, though still quite rapid enough in some places. Progress was farther impeded by shoals, bars, and head winds; and considerable time was, of course, occupied in climbing and examining the adjacent bluffs and mountains.

The geology of this region, as all know, is very interesting;

and the trip is believed to have thrown much light upon some of its leading problems. The results of the expedition will, of course, be officially made known in due time by the several parties participating, who have brought with them ample data, both in the form of notes and specimens.

160. Darwin's View of Christianity

History.—Written Oct. 11 to Nov. 13, 1883. In the hope that the American scientific journal *Science* might have more courage than the British scientific journal *Nature*, I sent this to its editor on Nov. 14th. It was returned on the 20th with reasons for not printing it. I then sent it to the *Radical Review*. At a later date I again published this episode and gave some additional details (see No. 225).

The Radical Review, Chicago, Vol. X, No. 16 (New Series, No. 46), December 1, 1883, p. 7.

We reproduce below (at the request of a correspondent) Mr. Darwin's letter to the German student, Nicolas Baron Mengden, with a translation of that portion of Professor Haeckel's Eisenach address of September 18, 1882, of which it formed a part, as relates to the circumstances that called it forth; all of which was omitted from the translation that appeared in *Nature* (xxvi, 540), and is not generally accessible to readers of English.

"That even Charles Darwin was penetrated by this religion of nature, and was no short-sighted adherent of any special sect, is obvious to everyone who is acquainted with his works. But as some of his countrymen, immediately after his death, stated the contrary, and as a few bigoted priests have even glorified Darwin as an orthodox follower of a specific confession of the English church, we may be permitted to refute this falsehood by an unequivocal proof. I am so fortunate as to be able to produce an inestimable document, hitherto unknown, which leaves no doubt on this point. A studious young man, animated by an honest zeal for knowledge, whom I had the pleasure of seeing again a few months ago among my pupils at Jena, had become perplexed through the reading of Darwin's works about the Christian belief in revelation, which he had hitherto regarded as the most valuable foundation of his convictions. Pressed by serious doubts he wrote to Darwin and asked him for enlightenment, especially as to his views of the immortality of the soul. Darwin sent him back word through a member of his family that he was old and unwell, and too much burdened with scientific labors to be able to answer these difficult questions. But the young truth-seeker did not rest content with this, and again addressed to the revered old man an appeal as touching as it was urgent. This time there came as an answer a letter from Darwin, written and signed by his own hand, in the following words:

'DOWN, BECKENHAM, KENT.
June 5, 1879.

'DEAR SIR:

'I am much engaged, an old man out of health, and I cannot spare time to answer your question fully—provided it can be answered. Science has nothing to do with Christ; except so far as the habit of scientific research makes a man cautious in admitting evidence. For myself I do not believe that there ever has been any revelation. As for a future life, every man must judge for himself between conflicting vague probabilities.

'Wishing you happiness,

'I remain, dear sir, yours faithfully,

'CHARLES DARWIN.'

"After this open confession no one will any longer be in doubt that the religion of Charles Darwin was none other than that of Goethe and Lessing, of Lamarck and Spinoza. This *monistic religion of humanity* stands in no way in antagonism to those fundamental doctrines of Christianity which establish its true value. For the universal love of mankind as the fundamental principle of morality is contained in the former as in the latter. Its original source, as Darwin has shown, is to be sought in the *social instincts* of the higher animals, those psychic functions which the latter have acquired through adaptation to coöperative social life, and have transmitted to men through heredity."

161. [The Appraisement of Literature]

History.—Remarks on the paper of Prof. G. Brown Goode entitled: Outline of a Scheme of Museum Classification, read March 21, 1882.

Transactions of the Anthropological Society of Washington, Vol II, Feb. 1, 1882, to May 15, 1883 (Smithsonian Miscellaneous Collections, No. 544), Washington, 1884, p. 7.

MR. HUTCHESON mentioned the need of good model guide-books, and named as one of the best of this class the *Friedrich's Bausteine.* He also called attention to the place assigned to "religious organizations and systems" under the general head "Moral Condition of Man," and said he thought it would more naturally fall under "Social Relations."

Mr. WARD concurred in this last view, at least in the abstract. He also reverted to Mr. Hutcheson's previous suggestion relative to the exhibition of epoch-making books, and spoke of the educational effect of such a feature on young persons who might desire to lay out a course of reading and wish to avoid the mass of literature of an ordinary or inferior quality which makes up the bulk of all great libraries.

162. [Difference between the Latin and the Teutonic Races in mixing with the Aborigines]

History.—Remarks on the paper by Prof. Otis T. Mason on The Treatment of the Aborigines by Colonists of Higher Races, read April 4, 1882.

Ibid., p. 9.

COL. SEELY remarked that in the Saxon invasion of England no assimilation of races took place, while invasions and migrations on the Continent of Europe were always accompanied by a mixture of races. He then drew the parallel with respect to the colonization of America. The portions colonized by the English exclusively showed no mixture with the aborigines, but the portions colonized wholly or in part by the Latin races showed such mixture. In Canada it was the French and not the English that had amalgamated, while in Mexico the Spaniards evinced the same readiness to combine with the natives that they did in South America.

Mr. WARD pointed out, in support of Col. Seely's statement, the peculiarly isolated position which the United States and Territories occupy in this respect, and maintained that this furnished conclusive proof that it was neither the latitude and resultant climate nor any essential difference between the character of the more northern and more southern tribes of Indians which caused their destruction, but that it was simply due to the different characteristics of the colonizing races; that while the Latin races readily amalgamate with the Indians, the Teutonic races, and particularly the Anglo-Saxon, have a strong aversion to doing so.

163. Society as a Domain of Natural Forces

History.—This paper was read before the Anthropological Society on May 2 and 16, 1882, occupying about an hour each time. It was virtually the treatment of the subject of the social forces as set forth in *Dynamic Sociology*, Chapter VII, and was presented orally, the manuscript having been sent to the printer. On the second occasion, however, I went into the history of the subject and read from my paper at the Boston Meeting of the A. A. A. S. (see No. 106, Vol. II., p. 269), and reviews of the same. I had also hung on the walls large charts of the classification of the social forces, which Dr. Frank Baker had made, and spoke to them. The paper was discussed at length by Dr. Baker and Major Powell. To some strictures of the latter I made a brief reply, an abstract of which is all that appears in the Transactions.

Ibid., pp. 13–14.

PRESIDENT POWELL remarked that the doctrine of Malthus was untrue; that natural selection could not be considered a law of anthropology; that social organization consisted essentially in a repeal of that law and substituted for the law of competition that of mutual assistance. Man has progressed, 1, through the law of ***mutual protection***, and 2, through the law of ***culture.*** The three stages of culture are 1, acculturation; 2, education; 3, investigation. He criticised the terms
14 "parasitic occupations," "state|craft," "priestcraft," and maintained that all these functions were necessary to the existence of society.

To these latter strictures Mr. Ward replied that no stigma was intended to be attached to any of these terms; that the scheme in which they occurred was exclusively economic, and that as these occupations were neither productive nor distributive, they had been called parasitic. Neither their necessity nor their usefulness was questioned, but they were used merely to denote that those thus employed had nothing to do with the production or distribution of wealth.

164. [The Sociological Meaning of Benevolent Institutions]

History.—Remarks on the paper of Dr. J. C. Welling on The Turning Point of Modern Sociological Science, read Nov. 7, 1882.

Ibid., pp. 31–33.

MR. WARD commented upon the views of Herbert Spencer, Mr. Greg, and other authors referred to by Dr. Welling, that the humanitarian and philanthropic enterprises of civilized nations were counteracting salutary tendencies of natural selection and weakening the powers of the race to cope with its environment. He said that the views of this school had always surprised
him, held as | they are by the best reasoners of the age. 32
He considered these altruistic undertakings of modern society as a simple continuation of the process of subduing hostile agencies in nature, in which process alone civilization consists. The present inhabitants of this latitude and climate could not exist here a single year without artificial aids. All the world outside the tropics would be uninhabitable for such an animal as man if he lacked the power to defend and protect himself by artificial devices. But for hostile agencies that prematurely destroy the greater part of all creatures that are born any species would soon overrun the whole globe. Man has done this solely through the

control of such agencies. The necessity for charitable institutions arises from the fact that such agencies still continue to be so far unsubjected that a large part of those born would succumb to them for anything which it is in their power to do. Charity means that those who, through social inequalities, have acquired more influence over adverse agencies than they personally need shall exercise that influence in protecting those who have acquired less. This enables these latter to withstand them, just as clothing, shelter, &c., enable mankind in general to do so. The same reasoning, therefore, which would do away with benevolent institutions, would, if logically carried out, do away with every form of protection that man has ever devised either to prevent the consequences of hostile influences, or to increase the effect of naturally friendly ones in nature. The result of such would be not to remand the race to the condition of savages, but to remand it to that of other animals with the normally circumscribed habits. All this he said was so exceedingly patent to him that it had always been a matter of the greatest astonishment that the views referred to could have been maintained by any rational being, and especially by some of the really deepest thinkers of our time. He could only account for it as a fact from the undue influence which the continued study of natural processes exerts in leading to the belief that they are the only legitimate processes, and that their results must be in some way superior to those of artificial processes. In many scientific minds this admiration for natural methods amounts to a sort of "nature-worship," or physiolatry, which he had sometimes imagined might be a "survival" of this form of religion among savages. It was, he said, easy to show that this belief in the superiority of the methods of nature was not only false, but the exact reverse of the truth, the genetic process being the very least economical of all processes. Yet, like all preconcep-
33 tions, such a belief has the effect to blind the best minds to the plainest truths.

165. Report of the Department of Fossil Plants of the United States National Museum for the Year 1882

History.—Written Jan. 2–5, 1883. This was my first report as Honorary Curator of Fossil Plants in the National Museum. In his report for 1881 (p. 109) Professor Goode mentions the fact that I had been appointed as such, but had not then entered upon my active duties. The appropriations for the National Museum were small, and it was a great advantage to have the different departments in charge of an officer of the Geological Survey. On the other hand it was convenient, and almost necessary, that I should have the collections of fossil plants under my immediate control for study, and I was very willing to take charge of them for the sake of this privilege. The same was true of the invertebrates, then in charge of Dr. C. A. White, also of the Geological Survey.

Annual Report of the Board of Regents of the Smithsonian Institution, for the Year 1882, Washington, 1884, pp. 150–151 (Reprint of the report of the Director of the U. S. National Museum, pp. 32–33).

THE extensive collection which had been received from Mr. Leo Lesquereux, of Columbus, Ohio, who had previously employed it in the preparation of his printed reports, and had catalogued and numbered it according to your instructions, was merely unpacked during the last months of 1881, and remained at the beginning of the year in a wholly unorganized condition. The bulk of the work done in the department has therefore been that of systematically classifying and arranging this material. This work was delayed by the necessity of having appropriate cases erected in the laboratory rooms to receive it, as also by the lack of assistance and the performance of duties in connection with the Geological Survey.

The deficiencies of a merely chronological catalogue rendered necessary the preparation of a much more complete and convenient slip catalogue, which could be systematically arranged and serve as an efficient aid in the progress of the work.

The catalogued material has been arranged in three series according to horizon, viz., the Cretaceous (chiefly from the Dakota Group), the Tertiary (including for convenience the Laramie Group, which Mr. Lesquereux considers to be Eocene), and the Carboniferous and lower formations (there being a few from the Old Red Sandstone of Ireland, and a few from the Silurian of New York).

The system of classification adopted is, in so far as this was practicable, that of Schimper, as given in his "Traité de Paléontologie Végétale," the most comprehensive work on the subject.

As the greater part of the undetermined material in the department belongs to the later formations, and as my field work for a great while will probably be chiefly confined

to these horizons, I have found it necessary to reserve, for the present at least, the whole of the Cretaceous and Tertiary collection, and retain it in the laboratory as a basis for comparison and investigation. For the same reason I have not thought best to select a reserve
series of the Carboniferous plants, and have prepared 151
the whole collection for exhibition in the cases below. [33]
It still remains on the balcony waiting the completion of the necessary cases.

Very little was done during the year in the way of original research or towards the elaboration of new material, owing to the time required in making these preparations.

Fifty-nine specimens of Alaskan fossils were sent in September by your instructions to Mr. Lesquereux to be figured. These have been returned. One specimen (No. 556) was sent August 15, to Dr. J. S. Newberry, to be used in connection with a report to be published by the Geological Survey.

The following is a summary of the state of the collection so far as regards specimens which have been specifically determined:

	Genera.	Species.	Specimens.
Carboniferous	53	177	1,550
Cretaceous	65	142	549
Tertiary	121	351	1,821
Total	239	670	3,920

The undetermined material consists chiefly of the thirty-one boxes collected by myself in 1881, and seven boxes collected by Captain Bendire.

166. Bibliography for 1882

History.—Written January 22, 1883.

Ibid., pp. 183–186 (Reprint, pp. 65–68).

WARD, LESTER F. Sketch of Professor John W. Powell.

(Popular Science Monthly, January, 1882, xx pp. 390–397.)

An account of the early life and exploits of Major Powell, and also of his later career as an explorer and geologist, as well as of his official labors as Director of Geological Surveys and of the Bureau of Ethnology. A portrait forms the frontispiece of the number.

——On the cause of the absence of trees on
184 the great plains. A paper read before the
[66] Biological Society of Washington, December 9, 1881.

(Kansas City Review of Science and Industry, March, 1882, pp. 697–702.)

A discussion of the question from the writer's observations, a statement of the leading facts, a review of current theories, and a statement of the conclusions which seem best warranted by all the data attainable.

——Guide to the flora of Washington and vicinity, by Lester F. Ward, A.M. Washington, Government Printing Office, 1881. 8vo. pp. 264, with map of Washington and vicinity.

This forms Bulletin of the United States National Museum No. 22, and Smithsonian Publication No. 444, and contains a general discussion of the botanical peculiarities of the country around Washington, an annotated catalogue of the plants, a summary by orders and groups, a check-list, and an appendix of suggestions to beginners; also a map of the region.

——Directions for collecting and preserving plants, by Lester F. Ward.

From Bulletin of the United States National Museum, No. 22. Washington: Published by the Smithsonian Institution, 1882. pp. 209–237.

——Check-list. Flora of Washington, D. C., and vicinity, by Lester F. Ward.

From Bulletin of the United States National Museum, No. 22. Washington: Published by the Smithsonian Institution, 1882. pp. 148–207.

——Scientific basis of positive political economy.

(International Review, April and May, 1882, xii, pp. 352–365; 439–453.)

These papers are chiefly devoted to the consideration of a new method of classifying natural phenomena, with a view to proving that a large part of such phenomena, including many forms of social activity, is within the sphere of human control through the exercise of intelligence and foresight. Slightly modified they will form the latter portion of chapter viii (vol. ii, pp. 76–106) of a work by the writer entitled "Dynamic Sociology, or Applied Social Science." In press.

——Kant's antinomies, in the light of modern science.

(Journal of Speculative Philosophy, October, 1881, xv, pp. 381–395.)

A paper read before the Centennial Anniversary Convention, of "Kant's Critique of Pure Reason," at Saratoga Springs, New York, July 6, 1881.

An argument to prove that the "theses" and "antitheses" of Kant's antinomies are legitimate scientific questions, and that modern science, in at least three of the four antinomies, points to the truth of the antithesis.

——Darwin as a botanist.

(Proceedings of the Biological Society of Washington, 1882, i, pp. 81–86.)

Read before the Darwin memorial meeting of the Biological Society of Washington, May 12, 1882.

A review of Darwin's botanical works, an explanation of his methods, and a summary of the philosophic results of his labors in this field.

——List of water-plants for carp-ponds.

Bulletin of the United States Fish Commission, 1882, pp. 22–25.) 185 [67]

A list of names of aquatic plants furnished by the superintendent of the carp-ponds is here revised, modern names substituted for obsolete ones, the locality and range of the species briefly indicated, and the plants arranged according to the prevailing system of botanical classification.

——Catalogue of a collection of Japanese woods presented to the United States National Museum by the University of Tokio, Japan.

(Proc. U. S. Nat. Mus., 1882, ii, pp. 308–311.)
The names appearing on the specimens of this collection are here arranged in their proper systematic order and their synonymy is given. A few partially named species were determined from the figures accompanying the specimens.

——Politico-social functions. Abstract of a paper read before the Anthropological Society of Washington, D. C., March 15, 1881.

(Trans. Anthro. Soc., Wash., 1882, i, pp. 39–42.)
This paper is chiefly devoted to pointing out the importance of a certain amount of judicious regulation on the part of society as a collective whole, of the more or less injurious and ruinous operations which must necessarily go on within it in the absence of such regulation.

——The postage question.

(Botanical Gazette, August and September, 1882, vii, pp. 97–99.)

Gives a correspondence between the Post-Office Department and the writer on the Department rulings relative to the form of label which would come within the law as fourth-class matter.

——"Decumaria barbara."

(Botanical Gazette, 1882, vii, pp. 99–100.)
An account of its collection in the Dismal Swamp of Virginia.

——Proterogyny in *Sparganium eurycarpum.*

(Botanical Gazette, 1882, vii, p. 100.)
A note recording the observation of this phenomenon in the District of Columbia.

——The anthropocentric theory.

(Transactions Anthropological Society of Washington, i, 1882, pp. 93–103.)
A collection of facts tending to prove and to disprove the existence of an intelligent control of events in the interest of man. The paper forms part of chapter viii (vol. ii, pp. 45–74) of "Dynamic Sociology." In press.

——What Mr. Ward was ready to say. (Herbert Spencer in America. New York: D. Appleton & Co., 1883. pp. 76–79.)

Portion of a letter complimentary to Mr. Spencer, written at the request of the committee of arrangements, to be read on the occasion of the banquet given him in New York, October 9, 1882. Before finishing the letter the writer concluded to attend the banquet in person. The matter of it was subsequently furnished the committee for publication.

——The organic compounds in their relations to life.

(American Naturalist, December, 1882, xvi, pp. 968–979.)

Read before the Philosophical Society of Washington, January 28, 1882, and before the Biological Section of the American Association for the Advancement of Science at Montreal, August 29, 1882. 186 [68]

A statement of the physico-chemical theory of life. The discussion in a much enlarged form is embodied in chapter iv (vol. i, pp. 300–356) of the writer's work "Dynamic Sociology." In press.

167. An Interesting Botanic Relic of the District of Columbia*

History.—I had seen this document in the second-hand bookstore of Mr. James Anglim, and on Oct. 11, 1883, when I happened to be in that store, Mr. Anglim not being present, his clerk handed it to me, saying that Mr. Anglim had instructed him to present it to me with his compliments. I took it home and read it carefully and identified all the plants mentioned in it by their modern names. Then, on Oct. 19th, I exhibited it at the Biological Society of Washington. On the 23d I received a request from Dr. Packard, then editor of the *American Naturalist*, to furnish him a note about it for publication. This was written on the 26th and forwarded to him.

I still possess this document.

The American Naturalist, Philadelphia, Vol. XVIII, No. 1, January, 1884, pp. 66–67.

AT a meeting of the Biological Society of Washington, held October 19th, Mr. Lester F. Ward exhibited the original manuscript proceedings of the Washington Botanical Society, which had accidentally fallen

* Communicated by Mr. Lester F. Ward.

into his hands. This society was formed in the year 1817, and continued in existence until 1826. It | numbered 67
among its founders and most active members, Rev. Dr. James Laurie, Dr. Alex. McWilliams and Dr. John A. Brereton, while Dr. Bigelow, of Boston, and Doctors Darlington and Barton, of Pennsylvania, were honorary members. Four years after the dissolution of this society Dr. Brereton published his "Floræ Columbianæ Prodromus," in the preface of which he briefly alludes to it. This work is still extant, and an analysis of its contents may be found in Mr. Ward's recently published "Flora of Washington."*

This allusion of Dr. Brereton was about all that was known of the history of the Botanical Society prior to the discovery of the above-mentioned document, which, containing as it does the names of all its members, its constitution and by-laws, and a careful record of all its work in the study of a then unknown and still remarkable flora, possesses great interest for local botanists. Mr. Ward promised that it should be ultimately so disposed of as to render it safe from the vicissitudes of either private individuals or ephemeral societies.

* Guide to the Flora of Washington and Vicinity. Bulletin No. 22, U. S. National Museum. Washington, Government Printing Office, 1881.

168. [Vital Force]

History.—Remark on the paper of Dr. Elliott Coues On the Possibilities of Protoplasm, read May 6, 1882.

Bulletin of the Philosophical Society of Washington, Washington, D. C., Vol. V, 1883, p. 105.

MR. WARD pointed out that very diverse views were held upon this subject by two classes of thinkers who do not come into intellectual contact. Furthermore, while not asserting that a belief in vital force was a superstition, attention was drawn to the fact that infantile races attribute all phenomena to supernatural agencies, and that, with increasing knowledge, there is a decrease in the number of these appeals to supernatural agencies.

169. Prof. Sumner's Social Classes[1]

History.—Written Jan. 6–7, 1884.

Man, New York, Vol. IV, No. 9, March 1, 1884, first and fourth pages.

THIS little book, from its very smallness, wil probably be widely read. It may do good or it may do harm. We think it wil do good. We say this, however, not because we agree with its general tone. On the contrary, we regard it as founded on radically false assumptions, but they ar assumptions which ar popular and ar supported by current theories. There is nothing new in the *matter* of the book. Every statement it contains has been made a thousand times, and nearly every illustration used is already threadbare in the same service. It is the *manner* alone that can hope to attract attention, and this, we must confess, is at least original.

The book is a sort of final wail against the modern practices of states and peoples which run counter to these current theories. The argument is simply the old cry: "*Laissez faire, laissez passer!*" It is the renewed appeal to State and other social agencies to cease their interference

[1] What Social Classes Owe to Each Other. By William Graham Sumner, Professor of Political and Social Science in Yale College. New York. Harper & Brothers. 1883.

with the natural laws of society as expressed in unrestricted private enterprise and freedom of trade. Notwithstanding the powerful array of alleged scientific theory by which this argument is supported, and the great and confessedly useful influence it formerly exerted, its rallying cries hav for many years lost much of their effectivness, and, without any very large body of doctrin to act from, states and nations, driven to it by popular demands, hav largely adopted the policy of restriction, regulation, and supervision. The countries of Continental Europe, less influenced by theoretical economists, led the way by many decades, and to-day most of the important public agencies, telegraphs, railroads, etc., ar under state control. In England the Liberal party resisted until it came into power, but was then compelled to yield to popular demands for interference. We now see there, in the land of Adam Smith, regulation of railroads, state education, postal telegraphy, the parcels post-law, temperance laws, landlord and tenant laws, an Irish land act, and a great body of legislation arising in large part from what is popularly called the "national conscience." In general, foreign commerce is there left free, as is obviously the true policy for an almost exclusively commercial nation; but when it is wished to discourage the importation of luxuries or injurious commodities, such as distilled liquors, the duties ar unsparingly laid on, often amounting to prohibition.

In America, to secure national self-dependence, develop mineral and other resources, encourage inventiv talent and home manufactures, diversify population, and avoid redundant transportation, duties hav from the first been levied on certain commodities and ar still so levied. We hav had a national postoffice, which Prof. Sumner probably admits to be a success; and we hav state, if not national, education. Other forms of state action ar demanded, among which ar those against certain monopolies, particularly those of transportation.

The various enterprises named, and many others which different states hav assumed, hav not been the wretched failures which the theorists describe, but successes of the most important kind, and it is experience and facts that continue to embolden men to demand additional ones. It is beginning to be recognized by many people that not only ar individuals often incompetent to manage those operations which specially affect the general public, but that the state *is* competent to manage them. This is strikingly shown in numerous instances; hence a form of mild but rather business-like popular clamor to be relieved of certain serious evils arising from the greed and incompetency of private individuals and corporations.

The practice is to listen to this form of appeal and cautiously but securely to adopt regulativ measures. So far has this tendency gone that the doctrinarians hav taken the alarm. They feel that practice is running counter to theory. *Laissez faire* has with them become a creed, and they feel as do religious devotees when they see their faith breaking down and their creed superseded by a more liberal and progressiv one. They hav already long ago said all there was to say. They can now only protest, threaten, and vituperate. All effect must henceforth come, if at all, from new forms of warfare, and this book aims to secure it in this way. Its method is thoroly *ex parte* and aggressiv. There is no attempt to conciliate, no hint at concession. The style is pungent and incisiv. All attempts at social reform ar unsparingly condemned, and reformers of every kind ar lashed and goaded in a merciless manner. The reader feels that the schoolmaster is indeed abroad, and so pointed and almost personal ar the author's assaults that there is scarcely any one who can fail to perceive that he is himself the unhappy victim. The laboring class and "the poor" in general ar handled with especial severity.

4 These ar given no quarter, and one is inclined to believe that they ar regarded as sheer intruders and cumberers of the earth.

The whole book is based on the fundamental error that the favors of this world ar distributed entirely according to merit. Poverty is only a proof of indolence and vice. Wealth simply shows the industry and virtue of the possessors! The very most is made of Malthusianism, and human activities ar degraded to a complete level with those of animals. Those who hav survived simply prove their fitness to survive; and the fact which all biologists perfectly understand, viz.; that fitness to survive is something wholly distinct from real superiority, is, of course ignored by the author because he is not a biologist, as all sociologists should be.

Laissez faire is "translated" into "blunt English" as meaning "mind your own business," and this injunction he drives home to almost every one who has ever done anything except to write about "what social classes owe to each other"; the salutary reservation of Sir Joseph Porter, "except me," seeming to be constantly kept in mind.

It would be wholly profitless to attempt to meet such an argument. Nearly every proposition in the book involves a fallacy, and one that has been repeatedly, as it is easily, pointed out. The author inveighs, as is the fashion, against meddling with natural laws, and interfering with the natural flow of events. He seems never to hav reflected that practical art as the product of applied science, and which alone constitutes man a civilized being, is the exclusiv effect of his meddling and interfering with the natural course of physical phenomena. The inventor is just the "meddler" he is belaboring. Or else he thinks that social phenomena form a complete exception, and ar not a domain of practical science such as can be put to any use. If so pray, why waste time in cultivating such a pseudo-science?

But his inconsistency is not confined to questions so profound. His own idea of true functions of government must condemn that institution even in its ideal form as an interference with the natural course of things. It should, he says, secure to all equal chances to pursue happiness.

But would not nature secure this without such institutional interference? Clearly, consistency must condemn all government, and proclaim anarchy pure and simple.

Again in his severe condemnation of the "friends of humanity," as he sneeringly calls all who believe in the attainment through human effort of a higher social state, he seems to forget that these very troublesome persons ar merely products of society and *natural.* To hear him, remembering his premises, one would suppose that these men either had invaded the world from some outer planet or had artificially created themselves. But they belong to society as much as the hated paupers and worthless invalids whom he would turn over to nature. Why then not let them alone? Why meddle with the natural course of things? In fact what is the *raison d'être* of this earnest book that wants to hav so much done? On his own theory, the author should let his deluded victims alone, should *laisser faire*—we omit the "translation."

We said we believed the book would do good. It wil show, as nothing else has done, that the *laissez faire* doctrin, if it could be carried to a logical conclusion, would be nihilistic and suicidal. This work goes to the utmost posible extreme short of complete consistency, and the network of absurdities in which this attempt has involved the author must serve to condemn the whole doctrin in the eyes of all readers whose opinions ar not already irrevocably fixed, *i. e.*, all whom it aims to convince.

This result wil be especially salutary at the present time, since it is only quite recently that the modern current of public policy has ever received anything like a theoretical analysis from a strictly philosophical standpoint, such for example as that which Mr. Lester F. Ward has given to it in his "Dynamic Sociology." For when thus fundamentally analyzed it appears that, after all, this is the really scientific side of the question, and is sustained by an impregnable bulwark of truly cosmical principles.

170. On Mesozoic Dicotyledons

History.—Written Nov. 15 to Dec. 24, 1883. The data were all collected and a rough outline drawn up by Nov. 16th, on which date I read it as a paper before the Biological Society of Washington. It was rewritten Dec. 6th–24th, and was first sent to *Science*, but declined by that journal for want of space, and with request to send a part. This I did not wish to do, and on the 30th Major Powell offered to send it himself to the editor of the *American Journal of Science.* It was accepted at once.

The American Journal of Science, New Haven, Third Series, Vol. XXVII [Whole Number CXXVII], No. 160, April, 1884, pp. 292–303.

IN the following remarks on Mesozoic Dicotyledons, I confine the term *Dicotyledons* to that sub-class of the vegetable kingdom which is embraced under the term *Angiosperms* in most modern text-books of botany. This is the usage of most vegetable paleontologists[1] and the reasons for adopting it have been frequently stated.[2]

[1] Göppert, Geinitz, and one or two others conform to the Jussiæan system.

[2] See the American Naturalist, vol. xii (June, 1878), pp. 359–378.

The Dicotyledons occupy somewhat the same position in the history and development of plants that the Mammalia occupy with respect to animals. They constitute the dominant type and in their rapid march have now so completely gained the ascendant as to dwarf all other forms into relative insignificance. They include nearly all the deciduous forest trees, the shrubby undergrowth, the leafy herbage and the weeds of all temperate regions.

But this has not always been the case. In fact the reign of the Dicotyledons, geologically considered, has been very brief. Although there is evidence that the earth has been covered with vegetation since the beginning of the Carboniferous age at least, still there is nothing to warrant us in saying that a single dicotyledonous plant existed prior to the close of the Jurassic. Indeed, we do not know from the actual discovery of specimens that this type appeared earlier than the second recognized group of the Cretaceous —the Urgonian. Until quite recently the presence of these plants in formations lower than the Miocene was so rare that it was with the Tertiary rather than with the Cretaceous that the existing dominant vegetation of the globe was assumed to have originated.

Notwithstanding this, some of the earliest, if not the very earliest, discoveries of these forms were in cretaceous strata. In the stone-quarries of the Harz mountains near Blankenburg, were found, near the beginning of the eighteenth century, prints of large leaves which the workmen believed to be those of the grape vine, and which were mentioned by Scheuchzer, Brückmann, and Walch, but without any attempt at their scientific determination.

A brief historical review of the discovery, identification and publication of dicotyledonous species in Cretaceous strata of Europe and America, including the arctic regions, will show the importance which this subject is assuming among paleontologists.

293 | In 1833 Zenker[3] took up in earnest the study of the Blankenburg leaf-prints and described, figured and named five species belonging to two genera. One of these genera he rightly concluded to have no living representatives, and he therefore named it *Credneria*, after his friend Professor Credner, who collected the specimens.

In 1841 Göppert[4] figured a number of dicotyledonous leaves from the Quadersandstein of Silesia, but did not venture to give names to them.

The next year Geinitz[5] identified three species in the lower Quader of Saxony at Niederschöna, the fossil flora of which place was so well worked up by Ettingshausen in 1867.

In 1845 Corda[6] figured some dozen leaves from Trziblitz, Luschitz, Perutz, and Weberschau, in Bohemia, some of which localities he placed in the Gault, but they are probably all in the Lower Quadersandstein, or Cenomanian. He made no attempt to refer these forms to genera and species.

Unger's *Synopsis*[7] appeared the same year, in which sixteen species of Cretaceous Dicotyledons are recognized down to that date. Göppert,[8] however, admitted only thirteen species in his table published in Bronn's *Naturgeschichte*, which also appeared in 1845.

[3] Beiträge zur Naturgeschichte der Urwelt, von Jonathan Carl Zenker. Jena, 1833.

[4] Ueber die fossile Flora der Quadersandsteinformation in Schlesien, etc., in Nova Acta Naturæ Curiosorum, vol. xix, Taf. xlvii, li, liii.

[5] Characteristik der Schichten und Petrefacten des sächsisch-böhmischen Kreidegebirges, von Dr. Hans Bruno Geinitz. Heft 3, Dresden and Leipzig, 1842, p. 97.

[6] In: Die Versteinerungen der böhmischen Kreideformation, von Aug. Em. Reuss. Stuttgart, 1845–46, Taf. l, li.

[7] Synopsis plantarum fossilium autore Fr. Unger, M. Dr., Lipsiæ, 1845.

[8] Naturgeschichte der drei Reiche, xv, 2 (Handbuch einer Geschichte der Natur, iii, 2) von Heinrich G. Bronn, Stuttgart, 1849, pp. 44–57 and 66.

Debey[9] in 1848 enumerates sixteen species as previously published and adds to these twenty-seven others from the neighborhood of Aix-la-Chapelle, most of which, however, he contents himself to call *Phyllites*, and as no figures were made, it is probable that some of these were not Dicotyledons. He also gives four *Carpolithes* which he identifies with dicotyledonous orders.

The same year Göppert[10] published a supplement to his Flora of the Quadersandstein in which a number of Dicotyledons are recognized.

In Ettingshausen's *Proteaceen der Vorwelt*, 1851,[11] four Creta |ceous species are enumerated, and Von Otto[12]
in his *Additamente*, 1852–54, also described Proteaceæ 294
from the Quader of Saxony; while Miquel[13] in 1853 described a few Dicotyledons from the upper Cretaceous of Limburg.

In 1856 Dunker[14] described and figured in the *Palæontographica* four species from Blankenburg in addition to those of Zenker, and one cluster of fruit which he believed to belong to *Credneria*, and to indicate strongly that those ancient plants belonged to the Polygonaceæ; Zenker had divined that they might be amarantaceous.

One year later Stiehler[15] reviewed in the *Palæontographica*

[9] Uebersicht der urweltlichen Pflanzen des Kreidegebirges überhaupt und der Aachener Kreideschichten insbesondere, von Dr. M. Debey, in Verhandlungen des naturhistorischen Vereines der preussischen Rheinlande, 5. Jahrgang 1848, p. 113.

[10] Zur Flora des Quadersandsteins, in Nova Acta Nat. Cur., xxii, 1, p. 365.

[11] Sitzungsberichte der mathem.-naturw. Classe der kaiserlichen Academie der Wissenschaften, Wien. Bd. vii, Heft iv, 1851, p. 711.

[12] Additamente zur Flora des Quadergebirges in Sachsen, von Ernst von Otto. Heft ii, Leipzig, 1854, p. 44.

[13] De fossile planten van het Krijt in het hertogdom Limburg, Haarlem, 1853. Verhand. Geol. Kaart Nederl., i, pp. 33–56.

[14] Ueber mehre Pflanzenreste aus dem Quadersandsteine von Blankenburg, von Wilhelm Dunker. Palæontographica, iv, 1856, pp. 179–183, tab. xxxii–xxxv.

[15] Beiträge zur Kenntniss der vorweltlichen Flora des Kreidegebirges

the whole subject of the Cretaceous flora of the Harz mountains, and added to all previous results the discoveries made by Hampe, a druggist of Blankenburg, in the marls near that place. Out of the numerous forms of *Credneria* he carves a new genus which he calls *Ettingshausenia*, and of which he makes eight species. He admits seven species of *Credneria*, and figures several others which he calls new species, but without assigning specific names to them.

Thus far America had contributed nothing to the flora of the Cretaceous, but in 1858 Heer described in the proceedings of the Academy of Natural Sciences of Philadelphia[16] eight species of Dicotyledons which had been collected by Doctor Hayden in Kansas and Nebraska. These, however, he erroneously believed to be Miocene.

The next year Mr. Lesquereux[17] contributed a paper to this Journal in which a number of fossil plants from Nanaimo, Vancouver's Island, and from Bellingham Bay were described as Miocene. It is now known that Nanaimo is Cretaceous, and his paper enumerates six species of Dicotyledons from that locality.

Nothing further appears to have been done until 1863, when Dr. Newberry[18] reported, in the Boston Journal of Natural History upon certain fossil plants from Orcas Island, British Columbia, collected by the Northwest
Boundary Commission. He | declared the horizon
295 Cretaceous, and among the plants described were four
Dicotyledons.

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im Harze, von August Wilhelm Stiehler. Palæontographica, v, pp. 45–80, Taf. ix–xv.

[16] Fossil Plants of the Lower Cretaceous beds of Kansas and Nebraska, by Oswald Heer. Proc. Acad. Nat. Sci., Phil., 1858, pp. 265, 266.

[17] On some fossil plants of recent formations, by L. Lesquereux, Am. Journ. Sci., II, xxvii, 1859, pp. 359–366.

[18] Descriptions of fossil plants collected by Mr. George Gibbs, Geologist to the U. S. Northwest Boundary Commission under Mr. Archibald Campbell, U. S. Commissioner, by J. S. Newberry. Boston Journ. Nat. Hist., vii, 1863, pp. 506–524.

In 1866 appeared the somewhat famous *Phyllites crétacées du Nebraska* of Capellini and Heer,[19] the latter of whom determined the fossil plants which the former had himself helped to collect at Blackbird Hill, Nebraska, in the now well known Dakota Group. The Cretaceous character of these fossils was here rather grudgingly conceded and has never since been seriously doubted.

While America had been thus coming forward Europe had remained in the background for about ten years, or since Stiehler's monograph of the Harz in 1857. It was not till 1867 that Ettingshausen[20] published in the Sitzungsberichte of the Vienna Academy his valuable paper on the fossil flora of Niederschöna in Saxony. The horizon of this place is considerably lower than that of Blankenburg and belongs at the base of the Quadersandstein formation of Germany. Nevertheless, the species nearly all belong to living genera—Quercus, Fagus, Ficus, Laurus, Protea, etc. Twenty-eight species are enumerated.

In the same volume Unger[21] described and figured four Dicotyledons, thus far unknown, from the Gosau (upper Senonian) of Austria, at St. Wolfgang and Neue Welt. Though contenting himself to call them all *Phyllites*, he yet ventured to assign two of them to the Magnoliaceæ and two to the Proteaceæ.

Returning to America, we find in 1868 the two most important contributions yet made in this country to the Cretaceous flora of the west. These were Dr. Newberry's *Notes on the later extinct floras of North America*, published in the Annals of the New York Lyceum of Natural History (April),[22] and Mr. Lesquereux's paper in this

[19] Verhandl. d. schweiz. Gesellsch. d. Naturf. Zurich, 1866.

[20] Die Kreideflora von Niederschoena in Sachsen, ein Beitrag zur Kenntniss der ältesten Dicotyledonengewächse, von Const. Freih. v. Ettingshausen. Sitzb. lv, Abth. 1, pp. 235–264, Taf. i–iii.

[21] Kreidepflanzen aus Oesterreich, von Dr. F. Unger, l. c. pp. 642–654, Taf. i, ii.

[22] The figures corresponding in the main to the species here described were published in separate form by the U. S. G. and G. Survey of the

Journal[23] for July of the same year. Though prepared quite independently of each other, these two papers followed the same method and reached the same results. Both authors give lists of the American Cretaceous species known up to that date, Dr. Newberry enumerating 20 and Mr. Lesquereux 21 Dicotyledons. The number of
296 species described | by Dr. Newberry as new was 45, and the number by Mr. Lesquereux was 47. Nine species from Fort Ellsworth, Kansas, included in Mr. Lesquereux's list, the descriptions of which did not appear until the following year,[24] do not enter into the figures above given. It will thus be seen that about seventy-five species of Dicotyledons had been described from the Dakota Group and other American Cretaceous strata down to the year 1869.

Far less could be said for Europe at this date. Hosius,[25] in 1869, was able to enumerate in his *Geognosie Westfalens* twenty-five characteristic species of the Quadersandstein, which had been described and figured either by Von der Marck[26] or by himself.[27] In this year, too, Heer published his *Fossil Flora of Moletein in Mähren*,[28] which belongs to

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Territories, F. V. Hayden, Geologist-in-charge, under the title: "Illustrations of Cretaceous and Tertiary Plants of the Western Territories of the United States," which did not appear until 1878.

[23] On some Cretaceous fossil Plants from Nebraska, by L. Lesquereux. Am. Journ. Sci., II, xlvi, 1868, pp. 91–105.

[24] On fossil leaves from Fort Ellsworth, Nebraska. Transactions of the American Philosophical Society, Philadelphia, vol. xiii, new series, pp. 430–433, pl. xxiii.

[25] Die in der Westfälischen Kreideformation vorkommenden Pflanzenreste (Beiträge zur Geognosie Westfalens), von A. Hosius. Münster, 1869.

[26] Fossile . . . Pflanzen aus dem Plattenkalk von Sendenhorst. Palæontographica, xi, 1865.

[27] Ueber einige Dicotyledonen der westfälischen Kreideformation, Palæontographica, xvii, 2, pp. 89–104, Taf. xii–xvii.

[28] Beiträge zur Kreideflora. I. Flora von Moletein in Mähren. Zurich, 1869.

the lower Quadersandstein, or base of the Cenomanian. Twelve species are described and carefully figured.

In Hayden's annual reports of the geological survey of the Territories for 1870 and 1871[29] Lesquereux continues to enlarge the list of American species, and in 1872, Heer,[30] in his *Fossil Flora of Quedlinburg* makes further additions to that of Europe.

We are thus brought down to the year 1874, which is marked by three very important publications.

Schimper's *Traité de Paléontologie Végétale* was completed in that year, in the fourth volume[31] of which 109 species of Cretaceous Dicotyledons are recognized. Of these 46 are American, which shows that the author was far behind in the literature of the subject. He also expresses serious doubts as to the Cretaceous age of these plants, although this had been long settled here beyond a peradventure.

Next should be mentioned Heer's *Kreideflora der Arctischen Zone*, which appeared in 1874 in volume three of his *Flora Fossilis Arctica*. In this work he describes one solitary dicotyledonous species (*Populus primæva*) in the schists of Kome—Urgonian—by far the most ancient form thus far met with, and 33 species in the higher strata of
Atane, which are now gener|ally believed to corre- 297
spond with the Cenomanian of Europe. These researches of Heer appeared too late to be embodied in Schimper's great work.

Finally, as crowning this fruitful year's labor, appeared Mr. Lesquereux's important quarto volume on the "Cretaceous Flora of the Western Territories,"[32] reviewing the

[29] On the fossil plants of the Cretaceous and Tertiary formations of Kansas and Nebraska, Ann. Rep. 1870, p. 370. Fossil Flora, Cretaceous Strata, Kansas, Ann. Rep. 1871, p. 301.

[30] Beiträge zur Kreideflora. II. Zur Kreideflora von Quedlinburg.

[31] Pp. 677–679.

[32] Contributions to the Fossil Flora of the Western Territories, Part I. The Cretaceous Flora. By L. Lesquereux, being Report of the U. S. Geological Survey of the Territories, F. V. Hayden, Geologist-in-charge, vol. vi. Washington, 1874.

results of all previous researches in this country, and describing and illustrating 107 species of American Cretaceous Dicotyledons. In Hayden's annual report for the same year[33] 26 species are described and some figured, but most of these were also more fully treated in the *Cretaceous Flora*.

During the succeeding six years little activity was manifested in this field, the attention of paleobotanists being principally directed to the floras of later formations, but in 1880 Hosius and Von der Marck published in the *Palæontographica*[34] their *Flora der westfälischen Kreideformation*, an important work reviewing the entire Cretaceous flora of Westphalia. Although fossil plants had been found throughout almost the entire Cretaceous series as there represented, still it was only in the Senonian that any Dicotyledons were detected. At two quite distinct horizons within the Senonian such plants were found, 37 species being credited to the upper and 24 to the lower Senonian, or 61 species.

Quite an important paper by Dr. Debey appeared in 1881[35] describing certain very interesting querciform leaves from the sands of Aix-la-Chapelle. Fifteen species are described and well illustrated, all of which are referred to *Dryophyllum*, a genus founded long ago by Debey on unpublished material and to which Saporta refers four of the forms from the travertines of Sézanne. It had been announced[36] that Debey had collected in the vicinity of Aix-la-Chapelle no less than two hundred species of dicotyledonous plants, and it is to be hoped that this paper may form a beginning, at least, of the much-needed work of acquainting vegetable paleontologists with the nature of this remarkable flora.

[33] Pp. 271–365, pl. i–viii. [34] Vol. xxvi, 1880.

[35] Sur les feuilles querciformes des sables d' Aix-la-Chapelle, par M. Debey. Bruxelles, 1881. (Compte rendu du Congrès de botanique et d' horticulture, 1880.)

[36] Schimper, Traité de Paléontologie Végétale, Paris, 1869-1874. Tome iii, pp. 671, 673.

The sixth volume of Heer's *Flora Fossilis Arctica* appeared in 1882. In this the Cretaceous flora of Kome and Atane are reviewed with fresh materials. While unable to find any com|panions for the solitary *Populus* of Kome, he 298
adds largely to the dicotyledonous flora of Atane. From 33 species in 1874 this flora now rises to 95. In the seventh volume of the same work, which unfortunately must now be the last, a new Cretaceous flora is announced, that of Patoot, also in Greenland, which is regarded as extreme upper Cretaceous. Dicotyledons here abound and no less than 74 species are made known in Heer's work.

Within the past few months an important paper has been contributed to the Royal Society of Canada by Principal Dawson,[37] in which 30 species, mostly new, from two distinct horizons of the Cretaceous of British Columbia are described and figured.

Lastly I am able to add to this enumeration one of the most important works that has ever been produced on vegetable paleontology, but which is still unpublished, though now ready for the press. I refer to Mr. Lesquereux's *Cretaceous and Tertiary Floras*, which is to form the eighth volume of the series of quartos of the U. S. Geological Survey of the Territories in charge of Dr. F. V. Hayden. In this work the author again exhaustively reviews the entire subject of the American Cretaceous flora, and we find the number of Dicotyledons thus far yielded by the Dakota Group to have reached 167. In his table of distribution he attempts to embrace the flora of the entire Cenomanian formation, to which he doubtless rightly believes our Dakota Group to belong. The total number of Dicotyledons thus marshaled is 312. Large as these figures seem, there is much reason to believe that they fall in both cases considerably below the actual state of science at the present time; as will be seen by the tabular statement given below.

[37] Transactions, pp. 15–34, pl. i–viii.

If we now turn from this strictly chronological enumeration to a consideration of the stratigraphical position in which these plants have been found, as indicating their relative age, we shall find the results no less interesting than is the history of their discovery.

The various countries of the globe where geology is studied have adopted divisions for their geological formations corresponding to the character of the rocks in each country. These divisions cannot be made to harmonize with exactness when it is sought to compare widely separated regions. The attempt here made to correlate the subdivisions of the European, Arctic and North American Cretaceous can therefore at best only lay claim to approximate accuracy.

299 The Quadersandstein of Germany, in which the greater part of the European fossil plants have been found, is an extensive formation, reaching in Saxony and Bohemia from the lower Cenomanian to the White Chalk, or upper Senonian. Its middle portion is occupied by the Pläner sandstone and Pläner marls, which extend downward into the upper Cenomanian and upward to the base of the Senonian. The somewhat local character and indefinite boundaries of the Quader formations have rendered it customary on the Continent, even with German geologists, to adopt the system of d'Orbigny as now modified, and to speak of the Cenomanian, Turonian and Senonian, instead of Lower Quader, Pläner and Upper Quader, and it is also now common to apply these terms to formations in other parts of the world which are supposed to occupy the same stratigraphical positions.

The leading European localities from which Cretaceous Dicotyledons have been collected are: Saxony (Niederschöna), Moravia (Moletein), Bohemia (Trziblitz, Perutz), Silesia (Oppeln, Tiefenfurth), the Harz district (Blankenburg, Quedlinburg), Westphalia (Legden, Sendenhorst), and the vicinity of Aix-la-Chapelle. The first four of these localities belong to the lower Quadersandstein, or Cenomanian, that of Niederschōna lying near its base. The Cretaceous of the Harz district is probably lower Senonian. In Westphalia, Hosius and Von der Marck find fossil Dicotyledons at two different horizons, both of which, however, they place in the Senonian. The region about Legden, Ahaus, Haltern, etc., is regarded as lower Senonian, while Sendenhorst, Haldem, etc., are said to be upper Senonian. The iron-sand near Aix-la-Chapelle is probably still higher and occupies the extreme upper Senonian.

The next greatest source, outside of the United States, of the class of fossils under consideration is Greenland. The Kome beds, as already remarked, are distinctly fixed in the Urgonian, which is lower Cretaceous, and lies between the Neocomian and the Gault. The discovery of a dicotyledonous plant at this horizon is one of the most interesting facts of paleontological science. The beds of Atane, where the greater part of the species were found, although called upper Cretaceous by Heer, are admitted by him to exhibit in their fossil remains so close a relationship with the American Dakota Group as to render it probable that they are of the same age. Patoot, on the other hand, is set down as extreme upper Cretaceous, and Heer says that its invertebrate fauna indicate its identity with the Fox Hills of our Western Territories.

The localities in British Columbia from which Cretaceous Dicotyledons have come are all regarded by the Canadian geologists as upper Cretaceous. The inland portions, situated|on the Pine and Peace rivers, are said by
Dr. Dawson to correspond to the Niobrora of the 300
northwestern United States, which he also correlates with the lower Senonian of Europe. Vancouver's Island and the localities on the Pacific coast are higher and are placed in the upper Senonian, though he does not correlate them with any of the groups of American geologists. Fossil plants were found on the Bow and Belly river which is said to agree with the Pierre Group but the dicotyledonous remains appear to have been indistinct and indeterminable.

With the exception of the Dakota Group, which is commonly regarded as Cenomanian, and in which such a profusion of dicotyledonous vegetation is embedded, no fossil plants have thus far been described from the Cretaceous of the western Territories. Nevertheless, I have myself collected and brought to Washington the past season some dicotyledonous leaves from a locality on the upper Missouri river some seven miles below Coal Banks, whose position is fixed with certainty in the Fort Pierre Group, No. 4 of Meek and Hayden, which Dr. C. A. White regards as merely forming the lower portion of the Fox Hills. The material thus obtained, though meager and fragmentary, is sufficient to render it quite certain that we here have forms nearly allied to *Platanus latiloba* of Newberry (*Sassafras mirabile* Lesqx.) and perhaps connecting this with *Platanus nobilis* Newby., from the Laramie strata that overlie these beds, as well as forms resembling *Quercus salicifolia* Newby., and other Cretaceous genera and species. There is therefore ground for hoping that when this and other similar localities are thoroughly studied a new Cretaceous flora may come to light in the northwest.

I have in this paper intentionally omitted all consideration of the great Laramie group although this is regarded by many as Cretaceous. This is because it seems at least to be more recent than any of the European, Arctic or British American plant-bearing beds, while its abundant flora consists in large part of types represented in the Miocene of Europe.

It thus appears that throughout both hemispheres the conditions required for the preservation of vegetable remains in Cretaceous time have existed in a marked degree during two epochs only, the Cenomanian and the Senonian, separated from each other by a period, perhaps equal to either, during which marine forms of animal life are chiefly found. A few Dicotyledons only occur in the Turonian of Europe, as e.g. *Magnolia telonnesis* from Toulon, while the Colorado Group (Fort Benton, Niobrara) of our

Western Territories have thus far proved destitute of plant life.

If now we take up the several subdivisions of the Cretaceous formation in their stratigraphical order, beginning with the|lowest, we shall see that in the Neocomian,
or lowest member, no plant remains of the sub-class 301
we have been studying have as yet ever been detected.[38]

In the Urgonian, or next higher group, one species, *Populus primæva* Heer, has been collected at Pattorfik in Greenland. In volume vi of his *Flora Fossilis Arctica*, which appeared in 1882, or eight years subsequent to the original description of this plant, Heer continued to adhere to this species as well as to its anomalous stratigraphical position.

The Gault, like the Neocomian, has thus far furnished no Dicotyledons, though not always destitute of plant remains.[39]

It is with the Cenomanian that there seems to have burst in upon the world a great and luxuriant dicotyledonous vegetation. It is found alike in Saxony, Bohemia, Silesia, in Greenland and in the western United States. Upwards of three hundred and fifty species, representing all three of the divisions of the sub-class (*Apetalæ, Polypetalæ, Gamopetalæ*), and consisting chiefly of living genera have been described.

It was formerly supposed that the beds at Blankenburg occupied a much lower position than that to which I have assigned them, and such as would place them in the Turonian, at least, if not in the Cenomanian, and Mr. Lesquereux,

[38] The supposed Neocomian Dicotyledons of Russia (Eichwald, Lethæa rossica, ii, pp. 58 et seq.) are shown by Heer (Fl. foss. arct. iii, Theil 2, S. 26) to come from the lower Senonian corresponding to the Harz district.

[39] Heer assigns the plant-beds of Spitzbergen to the Gault (l. c. S. 24), and Coemans finds nine new species of fossil plants in the Cretaceous of Hainaut (Mém. de l'acad. Royale de Belgique, xxxvi, 1867) which Briart and Cornet (l. c. xxxiii, p. 46) placed in the Gault.

in the large and important work which is about to appear,[40] includes the species of Heer's Quedlinburg Flora in his table of distribution of the Cenomanian. It is now quite certain, however, that the Cretaceous of the Harz district is much higher, and authorities seem to agree in placing it in the lower Senonian. On the other hand the upper boundaries of the Cenomanian in France and elsewhere are somewhat imperfectly established. For this and other reasons I have felt justified in relegating the few species that have been classed as Turonian to the Cenomanian, of which great group they seem to be but straggling outliers.

In the Senonian, both in Europe and in British Columbia, two quite distinct horizons for fossil plants seem to occur, separated from each other by a considerable interval. In view of this I have attempted to divide this group into two horizons and am thus able to show the lower and upper Senonian separately. From the lower Senonian we have about eighty species and from the upper about one hundred and eighty.

302 The following table exhibits the number of dicotyledonous species thus far recognized in each of the groups of the Cretaceous for the four principal geographical areas within which they have been collected:

Cretaceous Dicotyledons.

Geological Position.	Europe.	Greenland.	British America.	United States.	Total.
Upper Senonian.......	81	74	24	...	179
Lower Senonian.......	67	...	14	...	81
Turonian.............	..	...	..	...	...
Cenomanian / Dakota Group	53	114		184	351
Gault...............	...	...	...	...	...
Urgonian.............	...	1	..	...	1
Neocomian...........	...	...	..	...	...
Total..........	201	189	38	184	612

As all the plants with which we are here concerned are found in the Cretaceous some may be surprised that this

[40] Cretaceous and Tertiary Floras. Report of the U. S. Geol. Survey of the Territories, vol. viii. Washington, 1883.

paper should have been entitled *Mesozoic* rather than *Cretaceous* Dicotyledons. The reason for the title chosen is simply that it may tend somewhat to enlarge the view of the true history and age of this great type of vegetation. When we see that more than three hundred and fifty species of fully developed Dicotyledons, implying the existence of many more, were flourishing in all their present luxuriance in the middle Cretaceous, and that even in the lower Cretaceous one species is known to have existed belonging to a genus that still survives, we cannot if we would, repress the thought that the ancestors of these forms must have come down through older periods of the Mesozoic.

That we shall ever discover the true progenitors of the known Dicotyledons it is, of course, impossible to say, but that they had progenitors science no more hesitates to assume than any one would hesitate to assume that a foundling child must have had parents. Moreover, such is the slow and secular character of the development of living forms on the globe that no one would suppose it possible for so prominent a group of plants as were the Dicotyledons in the Cenomanian age to have attained that condition in anything short of a vast geologic period.

It is to be hoped that we are at last approaching the beginning, at least, of a solution of this truly great problem of the origin of the Dicotyledons. I have myself seen at least one slight, it may be, but very interesting sign of possible progress in this direction. Certain quite defective, but very instructive, specimens collected in the upper Jurassic of Virginia by Professor Wm. M. Fontaine, and which he kindly brought to|Washington for my in-
spection, certainly possess all the essential elements of 303
dicotyledonous leaves, although at the same time bearing a certain recognizable stamp of the cryptogamic and gymnospermous vegetation that characterizes that earlier age. What is to be the final verdict of science upon these forms cannot now be told, but it is to be hoped that the Mesozoic strata, not only in Virginia, but in all parts of the world,

may be diligently searched and the materials carefully studied, with a view to discovering these certainly merely "missing links" of a chain that can but have been once complete.

It is remarkable that both in its flora and its fauna the life of this continent has been thus abruptly truncated. The sudden irruption of a perfectly developed mammalian fauna at the beginning of the Tertiary is not less astonishing than the appearance unannounced of many hundreds of species of highly organized dicotyledonous plants in the middle Cretaceous. The advocates of special creation, and likewise the hunters after a lost Atlantis, were they informed upon the facts which science itself so plainly teaches, could ask no stronger argument for either of their positions. But such persons are usually not so informed, and it seems almost impossible for them to become so and still hold such views, for, fortunately, knowledge is a poison that contains its own antidote, and the very possession of the facts suffices to preclude a perverse use of them.

171. List of Plants Added to the Flora of Washington from April 1, 1882, to April 1, 1884.

History.—A list was prepared in the fall of 1882 and read before the Biological Society on Nov. 24th, as stated at the head of this paper, but it was not until January, 1884, that the list as here printed was made. It is true that my botanical activity was much less in 1883 and 1884 than it had previously been, and most of the additions made in those years were by others, as stated in the list under each case.

Proceedings of the Biological Society of Washington, Washington, D. C., Vol. II, 1882–1884, pp. 84–87.

(Read November 24, 1882.)

[This list is supplemental to Ward's "Guide to the Flora of Washington and Vicinity" (Bulletin, U. S. National Museum). Unless otherwise stated, the species enumerated were found by the author.]

40*a*. **Argemone Mexicana**, L. PRICKLY POPPY.

Above Georgetown, near the ice house. Dr. E. Foreman, June 17, 1883.

89*a*. **Viola canina**, L., var. **sylvestris**, Regel. DOG VIOLET.

Left bank of Rock Creek below Pierce's Mill. First found and reported by Mr. Horace B. Patton, in April, 1883. Collected by myself May 5, 1883.

93*a*. **Viola tricolor**, L. PANSY. HEART'S-EASE.

Reform School region, escaped and much reduced in size. June 25, 1882.

124*a*. **Scleranthus annuus**, L. KNAWEL.

Easby's Point. Theo. F. Streets, May 18, 1883.

142*a*. **Hibiscus Syriacus**, L. SHRUBBY ALTHÆA.

Escaped in many places.

142*b*. **Hibiscus esculentus**, L. OKRA. GUMBO.

Pierce's Mill road, near Tennallytown, Oct. 22, 1882.

208*a*. **Desmodium ochroleucum**, M. A. Curtis.

Mount Hamilton,* Dr. E. Foreman, Sept. 24, 1882. Should be collected before the middle of September.

234*a*. **Phaseolus diversifolius**, Pers. WILD BEAN.

Alexandria branch, B. & O. Railroad, above Uniontown, Sept. 10, 1882. Also by Dr. Foreman near Roache's Run, Va.

* The conspicuous hill opposite Mt. Olivet Cemetery, otherwise known as "Mulligan Hill" and "Munger's Hill," is thus designated on Boschke's "Topographical Map of the District of Columbia," 1880.

304*a*. **Callitriche Austini,** Eng.
North of Mount Hamilton. June 24, 1882.

85

| 331*a*. **Conium maculatum,** L. POISON HEMLOCK.
Rhode Island avenue, on a vacant lot near 17th street. June 17, 1883.

333*a*. **Cicuta bulbifera,** L. WATER HEMLOCK.
Alexandria Canal, opposite the Arlington estate. Dr. E. Foreman, 1882.

391*a*. **Eupatorium altissimum,** L.
Between the canal and the river, a short distance below Chain Bridge. First reported by Dr. Vasey and Dr. Chas. Mohr at the end of September, 1882. Collected there by myself Oct. 5, 1882.

436*a*. **Aster ericoides,** L., var. **villosus,** Gray.
Woodley Park, Sept. 17, 1882.

457*a*. **Pluchea camphorata,** DC. SALT-MARSH FLEABANE.
Marshall Hall, Md. Collected by Mr. O. M. Bryan in 1883; specimens sent to Dr. Foreman, and by him shown to me.

497*a*. **Galinsoga parviflora,** Cav.
Fourteenth street near G, July 25, 1882. First seen by Dr. Chas. Mohr. Since observed by myself on Sixteenth street.

502*a*. **Leucanthemum Parthenium,** Godron. FEVERFEW.
Park near B and Sixth streets, July 10, 1884. Canal road above Georgetown, June 17, 1883.

504*a*. **Senecio vulgaris,** L. COMMON GROUNDSEL.

Alexandria branch, B. & O. Railroad, a short distance above Uniontown, May 27, 1883.

536*a*. **Tragopogon porrifolius,** L. COMMON SALSIFY. OYSTER-PLANT.

Nearly the same locality as the preceding. Dr. Foreman, May, 1883.

543*a*. **Campanula aparinoides,** Pursh. MARSH BELLFLOWER.

Rock Creek. Mr. M. S. Bebb, 1863.

In preparing the "Flora," several species were admitted, which, though not yet seen by the author or any of the recent collectors, were yet vouched for by perfectly competent authorities who had themselves found them in earlier years. In harmony with the rule thus adopted, I now add, without hesitation, this species which Mr. Bebb informs me, in a letter, that he was in the habit of collecting in whilom days. From his description of the locality, I infer that the spot on which the plant grew is now under cultivation.

628*a*. **Lycopsis arvensis,** L. SMALL BUGLOSS.

Near the Outlet Lock, Dr. Foreman, 1882. Collected there by myself June 17, 1883.

86

629*a*. **Heliotropium Europæum,** L. HELIOTROPE.

Georgetown, near the Aqueduct Bridge, Mr. M. S. Bebb, 1863.

The above remarks on *Campanula aparinoides* apply equally to this species.

640*a*. **Cuscuta compacta,** Juss. DODDER.

Specimen found in the herbarium of the Department of Agriculture, collected near Washington by Dr. Vasey.

661*a*. **Gratiola aurea,** Muhl.

Specimen in my herbarium (wrongly labeled) collected on the Eastern Branch marsh, in 1873.

732*a*. **Scutellaria parvula,** Michx. SKULLCAP.

This species was simply overlooked in the catalogue. I have specimens collected by Prof. Chickering near the Insane Asylum, May 26, 1875.

738*a*. **Lamium purpureum,** L. DEAD-NETTLE.

Soldiers' Home grounds. I have fine specimens of this species which I collected in this locality July 20, 1873, but had overlooked in preparing the catalogue. The omission was observed by Mr. Patton, who still found it there in 1882, and I again met with it widely spreading through the grounds on May 20, 1883.

746*a*. **Plantago pusilla,** Nutt.

Near the southwest corner of the Soldiers' Home grounds (outside), May 20, 1883.

773*a*. **Polygonum tenue,** Michx.

Mount Hamilton, Dr. E. Foreman, Sept. 24, 1882. Collected by myself on both sides of the hill, Oct. 1, 1882.

797*a*. **Euphorbia mercurialina,** Michx.

In a communication dated Dec. 6, 1882, the late Dr. George Engelmann informed me that this species was once sent to him labeled Washington, D. C., by Mr. F. Pech, who collected here extensively.

884*a*. **Zannichellia palustris,** L.

In the canal, above Foundry Run, June 17, 1883.

986*a*. **Eriocaulon septangulare,** With.

Eastern Branch (between tides) above Uniontown, Sept. 10, 1882. Abundant in the Potomac below Analostan Island, and near Custis Spring.

87

| 986*b*. **Cyperus flavescens,** L.

Specimen found in herb. Dep't Agriculture, collected in 1872 by Mr. Rudolph Oldberg, in the vicinity of Washington.

990*a*. **Cyperus inflexus,** Muhl.

Chain Bridge, Dr. Chas. Mohr, September, 1882.

996*a*. **Cyperus refractus,** Eng.

Collected near Washington by Dr. George Vasey.

1002*a*. **Eleocharis Engelmanni,** Steud.

Dried pond above Sandy Landing, June 24, 1883.

1019*a*. **Rhynchospora fusca,** Roem. & Schult.

Specimens in herb. Department of Agriculture, collected in the vicinity of Washington by Dr. George Vasey.

1031*a*. **Carex muricata,** L.

Established in and around the Agricultural Department grounds, *fide* Dr. Vasey and Mr. Conant.

1128*a*. **Glyceria pallida,** Trin.

North side of Four Mile Run pond, Dr. Vasey, 1883.

1160*a*. **Hordeum jubatum,** L. SQUIRREL-TAIL GRASS.

Park near B and 4½ streets, July 10, 1882.

1169*a*. **Arrhenatherum avenaceum,** Beauv. OAT GRASS.

Hillside above Boundary street and Conn. Ave., June 17, 1882.

1195*a*. **Setaria Italica,** Kunth. MILLET, BENGAL GRASS.

Agricultural Department grounds, July 22, 1882.

1253*a*. **Isoetes Engelmanni,** Al. Br., var. **valida,** Eng. QUILLWORT.

Pool among rocks above Sandy Landing, June 11, 1882.

CORRECTIONS.

The following names should be substituted for those standing in the Check-list opposite these numbers:

236. **Rhynchosia tomentosa,** Hook. & Arn., var. **erecta,** Torr. & Gray.
989. **Cyperus microdontus,** Torr.
991. **Cyperus vegetus,** Willd.
1055. **Carex glaucodea,** Tuckerm.
1129. **Clyceria Canadnesis,** Trin.

172. Caulinites and Zamiostrobus

History.—Written April 17, 1884. It was very bold in me, but was a rather remarkable prophecy, to call Professor Lesquereux's supposed cone (*Zamiostrobus*) a cycadean trunk, as it was many years before I commenced my extensive investigations into the cycad floras. In June, 1890, at his request, I sent this specimen to Count Solms-Laubach, then the great authority on cycads, and on Oct. 22, 1890, I received a letter from him dated Sept. 9th, in which he said: "Returning from my vacation I find the *Zamiostrobus mirabilis*, which arrived in perfect condition. [He here tells how he proposes to study it by making several sections, and adds:] I can at least, after an inspection of the fossil, give you the opinion which I have gained since it came into my hands. As you say [I had sent him the present paper], the Zamiostrobus is certainly a trunk, and as I supposed, it belongs to the group of the Bennettiteæ, and therefore should henceforth be called *Bennettites mirabilis*." The sections were cut and he sent me slides, and always adhered to his opinion. In a later paper (No. 362) I gave the full synonymy.

Science, Cambridge, Massachusetts, Vol. III, No. 65, May 2, 1884, pp. 532–533.

AS *Science* has devoted a page of its valuable space to Mr. Joseph F. James's copies of Mr. Lesquereux's figures of these plants and his remarks thereon, in which, without having seen the specimens, he essays to overthrow the determinations of the venerable paleontologist, a word in reply may be justified as tending to correct the impression, already quite prevalent, that the determinations of vegetable paleontologists are in large measure mere guess-work.

As regards Caulinites fecundus, little need be said, since its problematical character was sufficiently insisted upon by Mr. Lesquereux in his description. The "capsules" are much smaller than those of Onoclea sensibilis, and are found in intimate relation with the stems which have been called Caulinites. The matrix is a light, fine-grained shale, showing the longitudinal, parallel nervation of these stems very clearly. It also contains fragments of dicotyledonous leaves which may have belonged to the plant that bore the fruit; but no ferns are present, as these would be clearly shown by their characteristic nervation. It is safe to say, that, if Mr. James had examined the fossils, he would not have said that there was "no doubt" in his "mind that Caulinites fecundus is nothing but a part of the fertile frond of Onoclea sensibilis."

As regards Zamiostrobus, however, there is "no doubt" that Mr. James is egregiously in error. His confident statements well illustrate the folly of discussing mere figures of objects that are in existence. He has entirely misapprehended the nature of the specimen; and this is not altogether the fault of Mr. Lesquereux's figure. The fossil is a

segment of a zone, cut out of a cylindrical or conical body which must have measured about eight inches in diameter. This segment was placed with the exterior surface upward in the drawing, in order to show somewhat in perspective both this surface and the radiate structure of the cross-section from the direction of the centre. The figure is defective in not showing the manifest angle which all the dark spots have on one side, and which fixes their true character as scars of former leaves. It is probably not a cone, as Mr. Lesquereux supposed, but a fragment of one of those | dwarfed cycadean stems or trunks which
533 formerly went by the name of Cycadoidea, but which the Marquis Saporta (Paléontologie française, Végétaux, II.) now divides up into the two new genera, Bolbopodium and Clathropodium. From an examination of his figures, I am inclined to refer it to the latter of these genera. Although found at Golden, Col., which is cretaceous or Laramie, still it is not impossible that this specimen may have been in some way brought to this spot from a locality higher up the adjacent slope, having a position stratigraphically lower.

173. The Claims of Political Science.

History.—On May 7–9, 1884, I wrote an article on "Political Science." It was rewritten May 11th–15th, and on May 17th I divided it into two distinct articles, calling the first "The Claims of Political Science," and the second "An Example in Political Science." I sent both to *Science* the same day. On June 5th I received acceptance of the first, and the second was returned. For the latter see No. 202.

Ibid., No. 72, June 20, 1884, p. 748.

IS there any valid reason why political science should not take its natural place among the sciences? That it has no such place is evident from the fact that it is almost wholly excluded from all the scientific journals that profess to be devoted to all the sciences. How many articles on political science have ever appeared in the *American Journal of Science*, in *Nature*, in *Science?* Can any other science be named of which the same can be said? It seems to be assumed that all that is ever said about national affairs must necessarily be of a partisan character, and be said, not for the sake of truth, but to serve some political party or private interest. Yet any one who has any faith in humanity must admit that a large amount of disinterested political work is being done. Those who deny this for the present will generally admit it for the past and the present is always becoming the past. But, even if this were not the case, it would still be true that scientific politics is theoretically possible.

Most sciences are more or less practical; i. e., they furnish the principles which underlie the useful arts. From pure science to pure art there are always three somewhat distinct steps. The first is the *discovery* of scientific principles; the second is the *invention* of the methods of applying these principles; and the third is the actual *application* of the principles. The first two or the last two of these steps may sometimes be so intimately blended as to render it difficult to detect the line of demarcation between them; but theoretically the three steps are always present. If, therefore, there is a political science, this must also be true of it. We will assume that there is such a science; that the operations of a state constitute a department of natural phenomena, which, like other natural phenomena, take place according to uniform laws. The pure science, then, consists in the discovery of these laws. The intermediate, or inventive, stage embraces the devising of methods for controlling the phenomena so as to cause them to follow advantageous channels, just as water, wind, and electricity are controlled. The third stage is simply the carrying-out of the methods thus devised.

Political science is one of the cases in which, in its present state at least, the first and second steps are very much blended. They are both embraced in legislation, which includes both discovery and invention. Yet the pure investigator is not entirely wanting; and the *ideal politician* or statesman would correctly represent the first stage, or pure political science. The executive branch of government fairly coincides with the third, or pure art, stage. The judiciary is properly legislative or inventive; but, in fact, it often performs executive or technologic functions.

Why, then, does not politics form a legitimate subject of scientific investigation? Why might not its discussion in strictly scientific societies and journals be permitted and encouraged? And would not this be one of the best checks that could be set to the mad surge of unreasoning partisanship that now fills the columns of the public press?

It will probably be replied, that the moment a scientific man should attempt to discuss current political issues, he would lose his scientific attitude and spirit. Were he to do so, he would certainly forfeit the respect and confidence of scientific men; but this would be contrary to our hypothesis that the discussion be scientific.

174. [Announcement of the Discovery of Clethra alnifolia near Bladensburg, Maryland]

History.—The discovery was made July 27, 1884.

The Pastime, Washington, D. C., Vol. III, No. 2, August, 1884.

NATIONAL MUSEUM.
WASHINGTON, July 30, 1884.

DEAR "PASTIME."

Please inform your readers that the beautiful *Clethra alnifolia*, Ait., White Alder, has been added to the flora of Washington. It may be seen now in full bloom, showy and fragrant, on a little spot half a mile above the Bladensburg mill, close to the mill race on its left bank, about thirty yards below a foot-bridge on which one can cross, and about one hundred yards above the sluice-way.

LESTER F. WARD.

175. Sweet Cicely as a Bur

History.—There was no response to this note, and when the Sixth Edition of Gray's *Manual* appeared in 1890, the fruit was characterized simply as "very bristly"; and even the much later great illustrated work of Britton and Brown (1897) is content to say "more or less bristly along the ribs." It is due, however, to the authors to say that in the figure of this species the fruit is shown to be upwardly barbed, while in that of the Western Sweet Cicely it appears unmistakably so.

It is interesting in this connection to remark that under the new rules of nomenclature which require that the name first given to a plant shall forever remain its name (No. 385) it was found by Dr. Britton that Rafinesque had proposed for this genus the name *Washingtonia*, in honor of George Washington, earlier in the same work than he had proposed the name *Osmorrhiza* for some of the species which he regarded as generically distinct. The name *Washingtonia* is therefore the true name of the genus, and it is fitting that the Father of his Country should be thus honored in a plant, albeit a somewhat humble one, which doubtless grew abundantly on his own estate.

Bulletin of the Torrey Botanical Club, New York, Vol. XI, No. 8, August, 1884, pp. 92–93.

YESTERDAY, while rambling among the shady ravines and hillsides of the Virginia shore of the Potomac, and immediately above this city, I observed that my clothing was bristling with slender, spindle-shaped burs, some of which made their presence felt by penetrating to my skin. Spanish needles! I said; but no, I had not seen the plant that day. A glance showed that they were the linear fruits of *Osmorrhiza longistylis*, very abundant there, its foliage wholly gone and leaving the dry branching stalks loaded with fruit which only needed to be touched to be shaken off, and through dense patches of which I had been walking. I had never been thus troubled before and my curiosity was excited, as I was not aware of this bur-like nature of the sweet cicely. It was useless to remove the burs till I had wholly left the place, when I made a business of it.

On carefully examining the seeds after I reached home I easily discovered the secret. The narrowed base of each fruit terminates in a sharp spinous point, and this is backwardly bearded with stiff, white bristles, closely simulating in form and function the grains of some Aristidas and other grasses. Wondering why I had not always known this, I at once turned to the books to see how the authors had described this peculiarity. To my great surprise I was unable to find any distinct mention in any work at my hand of this, certainly the most striking character of the genus. Bentham and Hooker's "Fructus * * * basi longius attenuatus; carpella * * * sursum ciliata" certainly does not describe it. Gray says: "Fruit * * * tapering downwards into a stalk-like base, * * * the carpels with *up-*

wardly bristly ribs"; while Chapman contents himself by merely mentioning the "carpels with bristly ribs." It seems clear that the function of these bristles and the narrowed base, as a means of distribution like other burs, cannot have been present to the minds of any of these authors, and I write this partly to ask where the discovery of this function in *Osmorrhiza* has been formally announced, if anywhere.

The barb being at the base of the seed, or at the point of attachment to the plant, it is necessary that it shall first drop off and depend upon finding the distributing agent in the course of its fall of | two or three feet. It is clear 93
that the device is a somewhat clumsy and ineffective one, but the habit of the plant to grow in dense patches renders the chances of success fully adequate to its needs, as any one may easily realize by walking through half an acre of it as I did.

WASHINGTON, D. C., August 16, 1884.

176. The Upper Missouri River System

History.—This paper and the one on Irrigation (No. 178, infra, p. 353) constituted the extended communication that I presented to the Philosophical Society of Washington on March 1, 1884, with the title: "Some Physical and Economic Features of the Upper Missouri System" (see the *Bulletin* of the Society, Vol. VII, p. 20). As it covered two somewhat distinct subjects, I subdivided it and treated each as a separate paper. This deals with the "physical features." It was originally written Feb. 13 to 21, 1884, and after being read as stated, it was rewritten April 23d to May 1st. Then there was delay in having the map and diagrams drawn. These were originally in the form of large charts hung on the walls to illustrate the paper. They were subsequently reduced to their present dimensions by a competent draftsman. No proof of this paper was sent me, and the word *corrasion* was misprinted *corrosion* on page 600.

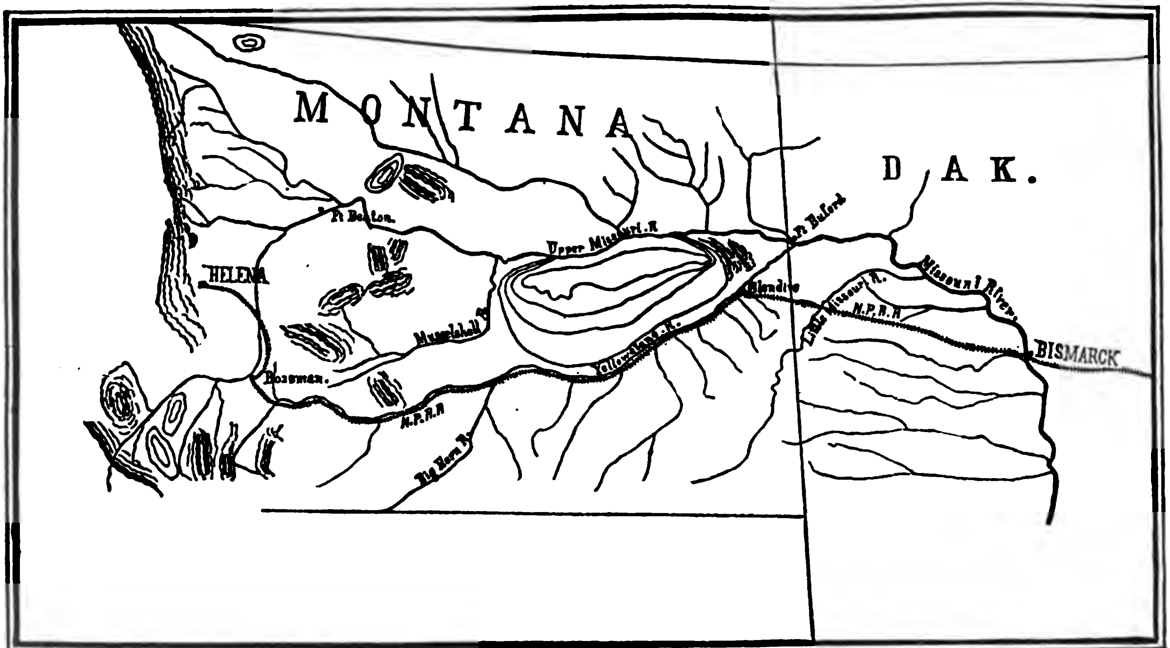

DIAGRAM NO. I.—UPPER MISSOURI RIVER SYSTEM.

Popular Science Monthly, New York, Vol. XXV, No. 5, September 1884, pp. 594–605.

THE Missouri River, as is well known, is the larger of the two great branches which unite to form the Lower Mississippi, discharging at its mouth 120,000 cubic feet of water per second, while the Upper Mississippi discharges only 105,000 cubic feet per second. It is therefore itself properly the Upper Mississippi. The perpetually turbid character of its waters is a familiar fact to the ordinary reader, even if he has never seen them.

It is proposed to state a few facts, derived from a season's personal observation in the valley of the Upper Missouri and of its nearly equal tributary, the Yellowstone, which may account for this condition, and serve to explain the peculiar form of erosion that characterizes this river system.

The upper portion of these rivers, where they flow through mountain-gorges, form deep cañons, and leap over wild cascades, is, of course, more interesting than their lower portions, where the flow, though rapid, is tolerably uniform through valleys of considerable width and among low sand-bars and islands of their own creation. As a consequence of this, we find that it is this upper portion that has received the chief attention by writers and explorers, who hasten through the | duller parts of the country and
make only a meager record of them. Another reason 595
for this has been that it is in the region of country about the sources of these rivers that the most profitable mining and agricultural enterprises have been conducted, and large and thriving settlements, even cities, have grown up there, unaided by railroad connections, and communicating with the civilized world by overland routes—not along the river-valley, but across the country from the south, uniting this region with the Salt Lake Basin. It is thus that Helena, Bozeman, Virginia City, and, to a large extent, Fort Benton, now a thriving town, have come into existence,

cut off, as it were, on the east, with the great valleys through which the waters of this region are led back to the inhabited parts of the country in a condition akin to unexplored. This was especially the case with the Yellowstone Valley prior to the construction of the Northern Pacific Railroad.

The Yellowstone, from its rapid current of about three miles per hour, its frequent sand-bars, shoals, rapids, and other obstructions, is scarcely navigable at all; while the Upper Missouri, though navigable with great difficulty in high water as far as Fort Benton, or even to its Great Falls, forty miles above that point, possesses a sad history of wrecks, disasters, and failures.

The Yellowstone and Upper Missouri Rivers flow in an easterly direction, nearly parallel to each other and at a distance of about one hundred miles apart, at least for the lower half of their course. Above the Musselshell, which stretches nearly across the intervening space, the country is more or less mountainous, the fall of the water is more rapid, the bottom usually gravelly or rocky, the valleys narrow, and the water clear except in times of flood. Below the Musselshell of the Missouri and the Big Horn of the Yellowstone, nearly opposite, this Mesopotamian region consists of an elevated plain wholly destitute of arborescent vegetation. Its elevation, though not sufficient to be called mountainous, is considerable, and is formed by several distinct rises or terraces. The summit is a level plain, and contains large lakes or marshes in which wild-geese and other water-fowls in immense numbers breed and rear their young. From this plateau long valleys, sometimes of considerable width, descend to the rivers, carrying streams of water which, in some cases, persist throughout the year. The highest part, or divide proper, between the rivers is not central but is nearer the Missouri, which has rugged banks on its south side, with some of the features of the Dakota Bad Lands. Toward the Yellowstone the slope is gradual, and the terraces become lower and lower until the river-valley proper is reached. The right bank of the Yellowstone

for most of this distance is similar to the right bank of the
Missouri, and toward its mouth the country lying south
of the river is not to be distinguished from the true Bad
Lands of the Little Missouri adjacent to it. On the other
hand, whatever wide flats or | low country the Missouri
here possesses are generally to be found on the north 597
or left bank of that river (see Diagram No. I).

Without attempting a description of those strange and interesting *mauvaises terres*, which are the favorite theme of popular writers, I shall endeavor to give some idea of the process by which the valleys of these rivers have been formed and of the action of the rivers within their present bed. It is quite evident that the entire configuration of the land-surface of the region has been the result of erosion, and distinct breaks or even low cliffs sometimes occur, showing the edges of the horizontal strata. At intervals of from five to ten miles small streams or creeks fall into the river, often entirely dry in summer, sometimes containing a small quantity of perfectly transparent water, but so charged with alkali as to whiten the pebbles over which it flows, and to render its use by man or beast almost impossible. These creeks, locally denominated *coulées*—a name given them by the early French explorers—have excavated valleys of different lengths and widths, and between these occur narrow plains, or even mere ridges. Of the immense volume of solid earth and rock that has been brought down by the process of eroding these terraces, creek-valleys, etc., only a minute fraction has been retained, but this has been deposited near the river, forming an alluvial bottom of varying width. This alluvial deposit it is the function of the river perpetually to wear away, while at the same time laying down new matter, with which it is constantly charged, to take its place. The result is, that throughout the lower portions of these rivers, and also in the Missouri Valley below their junction, the bed of the river is perpetually shifting its position in the general valley. When we contemplate the entire history of the

river, the valley must be regarded as due to this process, and its great width relatively to that of the stream itself can only thus be accounted for. But, if we contemplate it only at a given time, as the present, the valley appears to consist of two quite distinct parts, viz., the river-bed and the valley proper, raised above it and gradually sloping back on one or both sides to the foot of the first terrace. If, in time of low water, we compare these two parts, the latter will appear to be stable, while the former will clearly show that it is unstable. There was probably never a time in the river's history when these two distinct features did not exist much as now, though no one can say how many times the river may have worn away the stable portion of its valley on one side while it was forming anew on the other, and afterward receded and carried off the last-formed valley, leaving its previous bed to be again filled up until it has regained all the aspect of permanence which it previously possessed. This crossing and recrossing by the river-bed of the general valley, proceeding simultaneously with the work of lateral erosion, have gradually lowered the valley to its present position and are still lowering it. In a certain sense this applies to all rivers and river-valleys, but nowhere
perhaps | on the globe does there exist a better example
599 from which to study these principles of surface erosion
than in the Upper Missouri River system. This will be best seen when we consider a little more closely the proper bed of the river.

For two or three months of each year, between March and June, the river is high, and this state of high water is tolerably uniform from year to year, so as to be in a manner normal. Supplied chiefly from melting snows at greater and greater altitudes as the season advances, it persists with only slight fluctuations until the supply is exhausted, when the water slowly falls to its low-water mark, where it remains the rest of the year with only a small amount of variation, because the rainfall is so light. There thus exist two distinct and somewhat uniform conditions of the water,

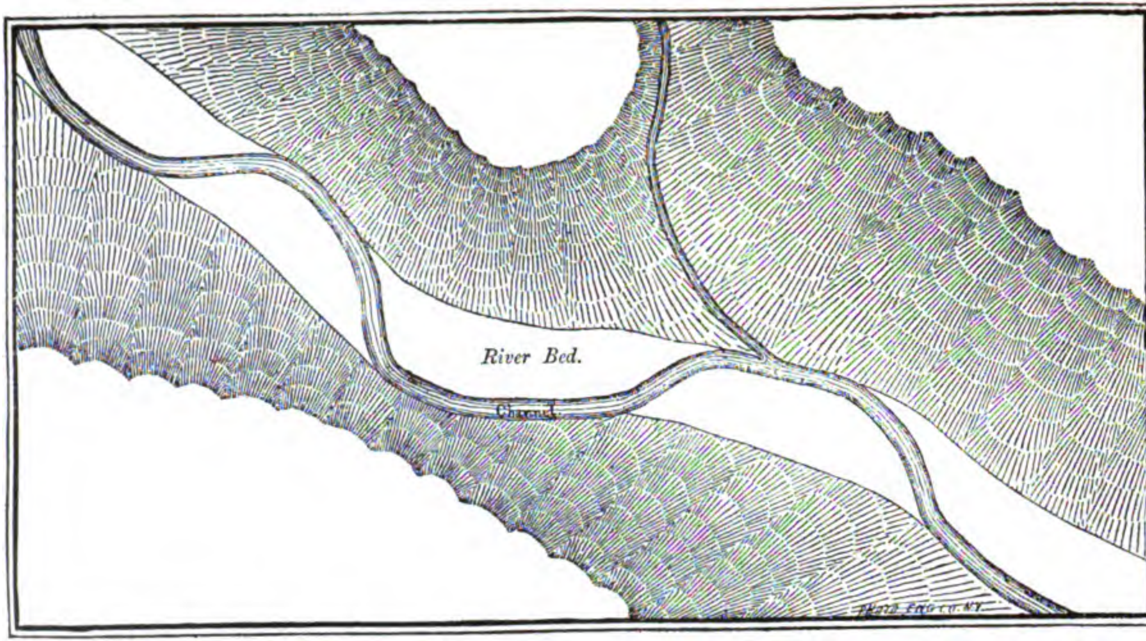

DIAGRAM NO. II.—PLAN OF RIVER VALLEY.

each occupying its regular part of the year. Owing to this regularity of high water, the maximum bed of the river produced by it is somewhat uniform and clearly marked, while it also bears a tolerably uniform relation to the deeper channel represented by the low-water state. Examined in time of low water, this river-bed seems to be three or four times as wide as the river itself. The stream, then, usually flows in serpentine curves which cross and recross the bed. The bed itself is also crooked much as is the channel, only its curves are as much longer as it is wider. The whole valley is usually also winding with much more ample curves, and the river-bed crosses and recrosses it in a manner similar to that in which the channel crosses and recrosses the bed. The river itself generally hugs one of the banks of the bed, but it is always at a curve, or bend, such as will tend to wear the bed on the convex side and thus render it more crooked. The distance traversed by the channel in crossing from one side of the bed to the other is small, compared with the distance traversed while in close contact with the bank of the river-bed, which it is perpetually extending into the general valley. The reason why it does not constantly grow wider is, that on the abandoned side the surface is being constantly raised by deposits of material which the water, more sluggish on this side, can no longer hold. As the river shifts its position in the valley, a strip of land of varying width is formed each year to be gradually assimilated to the permanent valley (see Diagram No. II).

If, now, we take the more general view and regard the entire valley as one homogeneous product, we can better study the process by which it has been formed. Beginning with the channel of the river we shall find that, except where crossing the bed, its cross-section presents a figure approaching more or less closely to a right-angled triangle with the right angle at the bottom, or deepest place. One side will then be formed by a steep wall or bank, which may become perpendicular above the surface of the water, but is not usually so below. The other side of the triangle represents the general bottom of the river, which gradually grows more shallow toward the remote side of the river-bed.

600 | At the deepest point, fresh erosion or corrasion is taking place, while the steep bank adjacent is being rapidly worn away (see Diagram No. III).

The features to be described can only be satisfactorily observed in time of low water. The bank above the river on the deep side is then generally very high, often rising perpendicularly twenty feet or more above the surface of the water. This high bank, thus exposed to the view of the navigator in the river, affords a most excellent opportunity of studying the manner in which the material composing the general valley has been deposited, the various agencies that combined to form the deposit, and the approximate time required for the accumulation of a given thickness of this alluvium.

These walls of loose earth are always very conspicuously stratified, the layers having various thicknesses and different colors. As many as a dozen distinct strata can usually be seen, often very definitely marked off from one another. The color of these layers enables the observer to determine, with considerable certainty in any case, whether it was due to a wash from the neighboring hills, whose color can be directly compared, or to a deposit from the river itself, brought in time of flood from points higher up, or, as is often the case, from vegetable mold which long immunity from disturbance has allowed to accumulate. Some idea of the time occupied in the total deposit may be formed from the presence of forests of cottonwood (*Populus monilifera*, Ait.) which line the river. These trees are sometimes of great size, measuring three or four feet in diameter, and, although the cottonwood is a rapidly growing tree, there can be no doubt that many of the trees are two or three hundred years old. But the mere presence of these forests standing upon the surface of the latest stratum of the general valley is by no means the only time-measure we have. A careful observer, though merely walking among them, might perceive that some of them have their bases buried to some little depth with alluvial earth or vegetable mold. This fact, which would escape any one who was not specially looking for evidences of it, becomes striking when the edges of the strata are viewed from the river.

As the river wears away the previously formed deposits of its valley, it at length approaches the portion that has had time to become covered with these forests. Undaunted, it attacks this portion also, and begins the work of felling the trees. Their roots are laid bare, the solid earth on which they have stood for ages is swept away, and one after another these ancient giants succumb to the rapacity of the waters, and fall powerless into the raging current. Every step in the process by which this result is accomplished may be seen by watching these eroded banks while floating down the stream. The river, as it passes one of these doomed forests, is choked with snags, through which the surging waters roar, and among which it is extremely difficult and often dangerous to guide a boat. These snags
are of all | ages, from the old "sawyers" that have 602
bowed before the current with rhythmic regularity perhaps for centuries, to the freshly-felled monarchs still bearing their green leaves of the season.

But the fact of chief interest is the presence of trees on the brink of these eroded walls, whose still living and healthy trunks are laid bare to a depth of several feet below the present surface of the ground. In some cases the subterranean portion occupies as many as four or five feet of the base of the trunk, descending through a number of distinct strata. But even at much greater depth there are frequent and unmistakable relics of ancient forests long since destroyed, or, as it were, buried alive. At depths of ten or twelve feet below the present surface, old stumps, with roots and remains of trunks, are brought to light by the inroads of the river. The trees which these represented must have been buried deeper and deeper, in the same manner as existing ones are proved to be undergoing burial, until, unable longer to perform the functions of circulation, they died, and all decayed except these deeply buried parts. Sometimes even these are gone, and naught remains beyond a reddish stain against the vertical wall to mark the spot where once there flourished upon the then surface of the valley a large and healthy tree (see Diagram No. IV).

The method thus far described of studying the mode of formation of the river-valley is that of *analysis*—the observation of the action of the water in disintegrating it. But we may also employ the method of *synthesis*, and study the manifest process of valley-building which takes place simultaneously. The river is always loading up on one side, and unloading on the other. The deepest part of the river near the high banks, as it sweeps round the great bends, is also the swiftest. The current grows slower and slower in the direction of the opposite shore, and at the same time the water grows more and more shallow, until at last a sand-bar is reached gradually rising out of it. If this proves to be the mainland, the case is simple, and we will first consider this simple case. This sand-bar was formed at the last period of high water in the spring and early summer. It therefore consists of sand only, without vegetation. It may have a width of fifty or a hundred feet when it ceases, and a distinct rise occurs, with a little terrace of sand, thickly covered with seedling willows, all belonging to one species (*Salix longifolia*, Muhl.), and bearing no other vegetation. The sand is still damp, being saturated with water from the river. This land is two years old. A short distance farther back another simi ar terrace is reached, bearing a thicket of this same w l ow but it is now two to four feet high, and fruit-bearing. The land is here three years old. Another remove brings us to a third terrace, having larger willows and some other vegetation, such as is not injured by periodical floods flowing over it. This four-year-old soil is darker in color and firmer. It may complete the river-bed proper,

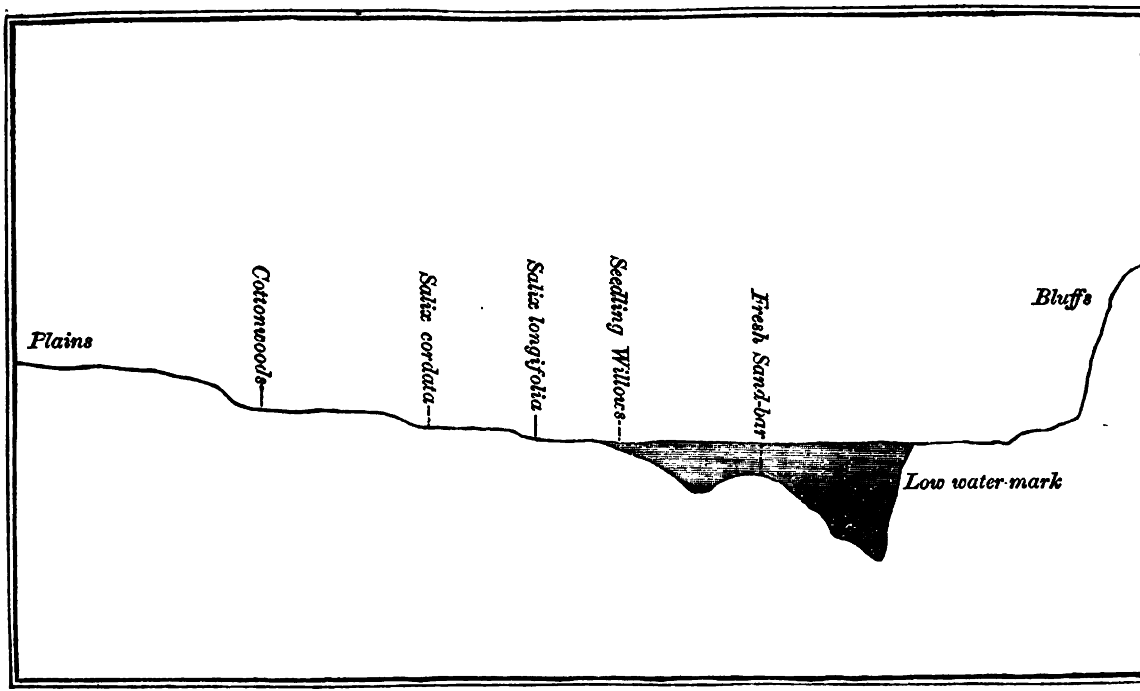

Diagram No. III.—Cross-Section of River Valley.

or there may be still another terrace. As we recede from the river, these old river-bed marks become | grad- 604
ually obliterated, and the valley seems to slope away with a gentle upward curve to the foot of the lowest hills. As soon as we are fairly out of the present river-bed the little willow gives way entirely to a large one (*Salix cordata*, Marshall), popularly known as the diamond willow. This species often grows very dense and in large clumps, forming an almost impenetrable thicket. It monopolizes the soil, and renders approach to the river difficult. It is at a point still more remote that the growth of cottonwoods begins, and these may form a belt half a mile to a mile in width. From the outer edge of these cottonwood-forests the plain commences, and stretches back, not only across the remainder of the valley, but far away in an uninterrupted sea of grass, until another river system is reached (see Diagram No. III).

Such, in its general outline, may be conceived to be the normal character of the Missouri and Yellowstone Rivers after they pass the mountainous part of their course and enter the portion where wide valleys prevail. But there are, of course, many deviations from this normal type. The fires may have destroyed the cottonwoods and willows that line the river and occupy most of its bed, and an unbroken plain may extend down to the sand-bars upon its banks. These sand-bars may form islands around which quite brisk currents flow even in the dry season. Sometimes, as at Spread-Eagle Bar, on the Missouri, a number of such bars occur, with shallow currents between them, wearing them away along clean-cut faces, and shifting their position from place to place, giving great width to the river. Large islands are often formed, which have accidentally escaped the denuding process, and, being beyond the reach of fires, become covered by a heavy growth of timber. Sometimes the bed of the river lies between two similar high banks, more or less central in the valley, showing that, instead of continuing to approach the bluffs on one side, its erosive action has from some cause been arrested or reversed. In such cases there is occasionally found a nearly equal current against each bank, but usually, even here, the main channel is snug against one of the walls, which it is rapidly carrying away, while the opposite wall has an ancient or obsolete appearance, with shoals or bars at its base. Of course, the entire configuration of the country is modified by the occurrence at short intervals of tributary streams with their valleys. These streams, in spring, contain considerable water; but, throughout the summer and autumn, most of them are perfectly dry, at least at their point of junction with the river, whatever water they receive from rains or springs being evaporated in their passage across the arid plains. One is greatly astonished to find no water, or only a rivulet, at the mouths of what are called rivers, and which drain hundreds of square miles of country.

But the Missouri and Yellowstone themselves never go dry. They are large and rapid streams at the dryest seasons of the year, and their turbid waters surge past like a resistless tide. They wear down their | valleys by slowly
605
crossing and recrossing them, like a turner's chisel. Once at their limit on a given side, they may be imagined to halt and turn back. The form of the bottom is changed and the point of greatest activity transferred from one side to the other; the sand-bars are first removed, and then the willow-belt is carried away; next they attack the forest of cottonwoods, and mercilessly sacrifice these; still undaunted, they invade the higher parts of the valley, wear-away wide stretches of plain, and slowly march up to the foot of the adjacent hills and mountains, which they also attack and undermine, until, checked by the increasing quantity of *débris*, and driven back by the very magnitude of their own trophies, they beat a retreat, only to repeat for the thousandth time the process which we have thus hastily sketched.

177. [Government Support of Irrigation Works in the West]

History.—Written at the request of the editor, as an editorial apropos of the next paper, July 23–24, 1884.

Science, New York, Vol. IV, No. 82, Aug. 29, 1884, pp. 158–159.

THE necessity of irrigating extensive tracts of the west has taught us that irrigation has its advantages. The crops raised under it are not only larger, but more reliable, than those of districts where irrigation is not considered necessary. It is somewhat as though the farmer could control the amount and frequency of rainfall, and it shows, that, in countries where the rainfall is abundant, it is distributed in a manner that comes far short of the best. In some parts of the west there is water enough for irrigating purposes, but it flows in large rivers which it would require great expense to turn upon the land. The Upper Missouri and Yellowstone rivers belong to this class. They flow through arid but otherwise fertile districts. They are large and permanent streams, and it seems a calamity that they should be allowed to run forever to waste.

The suggestion of a contributor in another column, that the government take time by the forelock, forestall mo-

nopoly, and lead population into this section by establishing gigantic irrigating-works for the utilization of this valuable water, is not so wild as many of the schemes that actually have been put through Congress; as, for example, the Pacific railroad schemes. Is agriculture any less important than commerce? Yet it seems as though, in this chiefly agricultural country, it is the only interest that is unable to obtain a hearing. It has not even a cabinet officer to represent it. To judge from the space assigned to it at the Centennial exhibition, as compared with that devoted to war, for example, one would have supposed that war was the leading occupation of Americans, rather than agriculture. The question of irrigating the arid but irrigable portion of our public domain is destined to
159 | become a leading one in the near future; and our statesmen will do well to begin soon to give it their thoughtful attention.

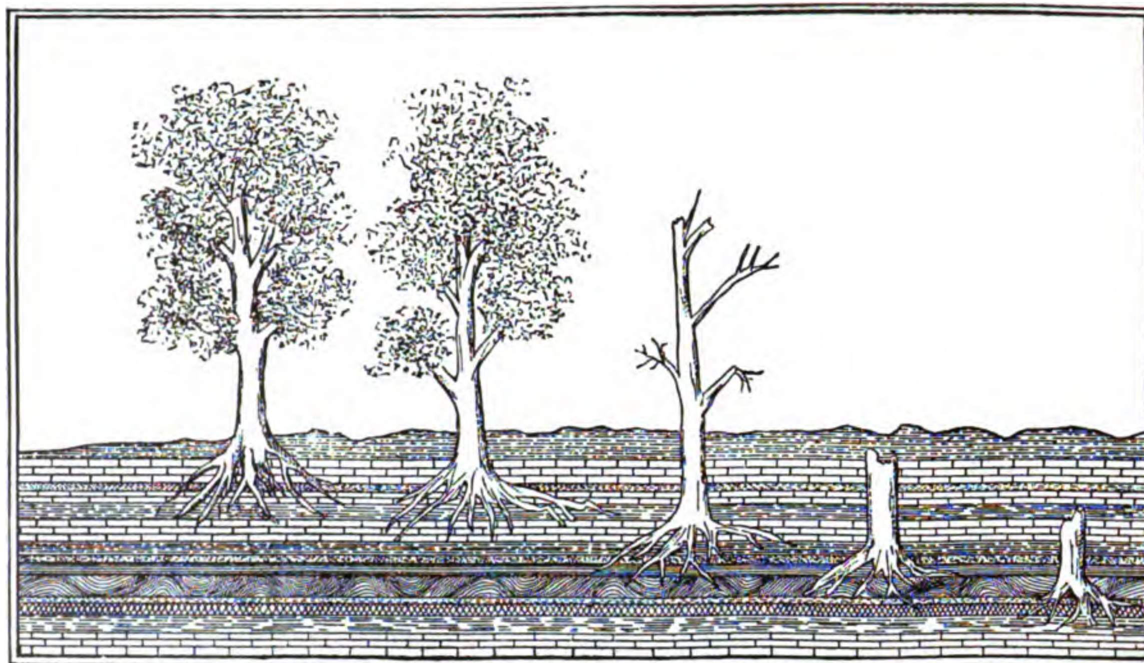

DIAGRAM NO. IV.—EXPOSED SECTION OF RIVER BANK.

178. Irrigation in the Upper Missouri and Yellowstone Valleys

History.—Written Feb. 20–21, 1884; rewritten May 16–23, 1884. (See No. 176, supra, p. 340, where the full history is given.) I need only remark here that this was about the first appeal that was made for the conservation of the water resources of the West. The Geological Survey established a Reclamation Division, though at a much later date, and large appropriations have been made for carrying on the work of systematic irrigation, but, so far as I am aware, the region here in question has thus far remained untouched, though there are some recent projects looking towards it.

Ibid., pp. 166–168.

IN crossing the great plains over the Union Pacific railroad, through Nebraska and Wyoming, or over the Kansas division through Kansas and Colorado, one is struck not only by the aridity of the country, but also by the fact that no streams of water exist there, adequate, if completely utilized, to irrigate any considerable part of that immense area. One is also struck by the monotony of the physical features, the absence of mountains or hilly areas, as well as of timber. The possibility of settling this vast region seems very remote; and only the discovery of some new and as yet untried method can prevent these plains from constituting, for ages to come, the great natural barrier between the east and the west,—a barrier far more complete than that furnished by the Rocky Mountains themselves.

This condition exists to a greater or less extent as we go southward, though the direction of this belt of uninhabitable country lies somewhat to the west of south. Before I had seen Dakota or Montana, I feared, when reflecting upon these facts, that such a belt might extend northward also, and thus, as it were, actually divide the United States into two sections, marked off from each other by a permanent physical obstruction. This problem seemed to me of the utmost importance, for it is the remote future that must be considered; and if the country has proved capable of so nearly dividing upon an east-and-west line, where there does not exist a single natural feature to render the two sections distinct, what might not be apprehended at some future day, when sectional differences arise between the east and the west, if cut off from each other by an uninhabited desert five hundred miles in width?

It was therefore with special interest that I studied the northern extension of this belt. The fact that the isohyetals actually curve eastward, i. e., that the precipitation is less as we go northward on a given meridian, led me to suppose that the difficulties would not diminish. It is certain, however, that the decreased evaporation, due to the reduced temperatures of the more northern parts of the dry belt, much more than compensate for the difference of rainfall. It is, moreover, currently believed by the inhabitants of these more northern districts, that the atmosphere is constantly kept somewhat moist by the influence of the Pacific coast and the Upper Columbia region. A short sojourn on the Upper Missouri and Yellowstone Rivers convinced me of the accuracy of this view. The general movement of the atmosphere is from west to east. The mountains to the westward are not high—at least, except at isolated points,—and do not, therefore, suffice to condense all the moisture that passes over them. Near the sources of these streams, as at Bozeman, crops are raised without irrigation, whenever they can withstand the frosts, although the rainfall is there only sixteen inches per annum; and the same is true for eastern Dakota, with no greater precipitation. It is also a matter of record, that the temperature on this latitude diminishes toward the east, and that colder weather prevails in Minnesota than in Dakota, and in Dakota than in Montana. The people attribute this to the occurrence of what they denominate "Chinook winds;" i. e., winds laden with moisture, and moderated in temperature from the warmer regions of the Pacific slope.

Notwithstanding this, it must still be confessed, that, for all the lower parts of this region of country—the proper valleys of these rivers—irrigation is essential to successful agriculture. All statements to the contrary are inspired by interest, usually by the railroad interest, which hopes thereby to increase travel. A number of instances of this came to my notice, one in particular, in which a resident who had published such a statement in a railroad circular was found reaping a field of unfilled oats, six inches high, to be stacked for fodder.

Is this country, then, inhabitable, i. e., capable of sustaining a population? No one will deny that it now possesses advantages for stock-raising; but a country which is only fit for flock and herds can never have sufficient population to give it importance in a state. A mining region may attract enough inhabitants to become somewhat influential, and will remain so as long as the mines continue to yield. But the only permanent and reliable basis of population is agriculture. It is not necessary, however, that all the land be devoted to agriculture: in fact, it really needs that only

a small portion of the soil be actually under the plough to support comfortably a region in which other operations can be carried on in parts not adapted to agriculture. If that portion of the Upper Missouri and Yellowstone valleys which lies between the river and the first general rise or terrace, including the valleys of the numerous *coulées*, or creeks, that flow into it as far as the same level would extend, could be adequately irrigated, this area would furnish an agricultural basis, sufficient, with the great
167 stock-raising region that lies back of it, to | guarantee the ultimate settlement of the country to any required degree of density. I speak of the valleys of these rivers, because it is along these that railroads are either already constructed, or are soon to be constructed; and also, because, whatever may be the case elsewhere, a large part of these valleys far above the flood-line is alluvial in character, and highly fertile.

Now, in comparing this region once more with that of the Upper Platte, whether with the south fork in Colorado, or with the north fork in Wyoming, one great distinguishing fact of the utmost importance presents itself. This fact is, that while, if every drop of the water that flows in the Platte and its tributaries could be turned upon the land, it would only irrigate a small fraction of its own valley, we have in the Missouri and Yellowstone, even in August, a volume of water large enough, if economically applied to this object, to convert the whole of the arable land lying adjacent to them into a rich agricultural region.

Major Powell and his able assistants have carefully calculated the relation of water-supply to irrigable territory; and they come to the conclusion that in Utah a flow of one cubic foot per second will irrigate one hundred acres of land. If this should prove a low estimate for Utah, where evaporation is so rapid that it dries up large rivers almost in their course, it would certainly be ample in the region of Chinook winds.

The volume of water carried by the Upper Missouri and

Yellowstone for that part of their course of which we are speaking has not been definitely ascertained. The average annual discharge of the Missouri River at its mouth was determined by Humphreys and Abbott at 120,000 cubic feet per second. A measurement was once taken at the source of the Upper Missouri, i. e., at Three Forks, at a time when the river was found to be four feet below high water, and eight inches above low water, when the volume was found to be 8,541 cubic feet per second. Between these two great extremes we are compelled to estimate for our present purposes. Perhaps 50,000 cubic feet per second would not be an excessive estimate for the volume of the Missouri below the mouth of the Yellowstone; or, assuming, as is claimed, an equal volume for each branch, 25,000 feet each for the two rivers above their junction. The calculation should not be based upon low water, since little use can be made of water in August and September, when the rivers are lowest; while it is in May and June, when the water is still high, that irrigation is chiefly required.

Each of these rivers, could all their water be utilized, would irrigate, at the above estimate, 2,500,000 acres, or nearly 4,000 square miles. This average would hold for points higher up; since the supply of these streams from their tributaries scarcely exceeds the evaporation, and the Missouri is not much larger at Fort Union than at Fort Benton. The distance between these points, by the windings of the river, is 669 miles. If the valley of this river could be irrigated to a width, on an average, of two miles, this would make, at the most, less than 1,400 square miles of surface. This, however, would be reduced in many ways. The smaller curves would be straightened. Much of the way the valley is narrow, and for long stretches, especially in the upper portion, it is reduced to a mere cañon: 1,000 square miles, or 640,000 acres, would be a large estimate for this portion of the Upper Missouri, which certainly would not require more than half of the available water. The same would be true of the Yellowstone; and thus, after thoroughly irrigating their own valleys, these great rivers might, should this be found practicable, furnish large quantities of water, to be conducted from points near their elevated sources to other outlying fertile tracts, which would also become the centres of a wide-spread and thrifty population.

To this scheme, I am aware, many minor objections may be raised, such as the destruction of navigation, about which there would be differences of opinion, but especially respecting the method by which it could be put into practice. This latter question, neglecting all details, we may now briefly consider in its most general aspects.

It is in the nature of things, that the settlers themselves of the districts in question can never carry out this extensive system of irrigation. To be made a practical success, it would require an immense outlay of capital. The few who will go there, knowing that no such system exists, could never afford to inaugurate it. The effect of its not being done must be to prevent its ever being done: therefore, under the ordinary laws of supply and demand, it can never be accomplished; yet no one in this age of great engineering enterprises will deny the physical possibility of such a scheme. Scarcely any one, probably, could be found to question its importance. It must be clear to all, that, if the means of readily irrigating these lands existed, that country would be rapidly filled up by a thriving agricultural population, which would bring after it its customary train of
168 civilizing agencies. | And the political-economist knows that this means increase of national wealth, while the statesman sees in it enhanced national stability and power. Yet, by the natural method on which civilization advances, the conditions to this much-needed settlement can never be secured.

Notwithstanding this, I believe this end will yet be reached. The human race is rapidly outgrowing the natural or genetic method. There is another method, scarcely as yet recognized by the political-economists, but which is being more and more resorted to by enlightened men for overcoming such great physical obstacles to the attainment of clearly-perceived advantages. This is the method of foresight, or calculation. Individuals employ it for the attainment of both private and public ends. Capitalists combine, and lead civilization into regions it would otherwise never have penetrated. It is very probable that a gigantic irrigating company will some time be formed, which will, by degrees, accomplish more or less satisfactorily the desired object. But, in such case, great evils are likely to result—evils analogous to those that have arisen from permitting great corporations to construct much-needed transcontinental lines of railway. An immense irrigation monopoly would inevitably grow up, which would largely neutralize the benefits derived from the project. Settlement would be impeded by excessive water-rates; and endless litigation, and conflicting legal decisions, would constantly deter population, and jeopardize industry.

A far better plan would undoubtedly be state action. If the territory of Montana possessed the means to undertake such a scheme, it could scarcely fail to prove highly remunerative at the end of a certain period. But here some such an obstacle exists as in the case of mere spontaneous settlement. Not until these tracts are already well-peopled will the territory possess the means of inducing settlement; and we have again a 'vicious circle,' which ends where it begins.

The only unobjectionable plan, as it seems to me, is *national* action. The nation is the largest of all capitalists, and, at the same time, has no tendencies towards monopoly. If we could obtain the same degree of collective foresight in the general government as exists in the average capitalist, nothing could be easier than for the United States, acting as a corporation that seeks only its own interest, not only to secure the particular end of which we are now speaking, but to develop its own resources, and increase its wealth and prosperity in numberless other directions, by the ordinary exercise of such foresight.

The present case seems to be one in which the nation has a special interest, rendering it peculiarly fitting that it should extend its aid. It is of the utmost importance as a matter of *national* security, and of immunity from dangers which no statesman can foresee, that the rapidly-growing west, with its peculiar interests, be cemented as speedily and firmly as possible to the east; and nothing can so effectually secure this end as to make the population of the entire Union an unbroken phalanx from the Atlantic to the Pacific.

179. Mind as a Social Factor

History.—Outlined Nov. 23 to Dec. 23, 1883. Read before the Anthropological Society of Washington, Feb. 19, 1884 (see No. 198). Rewritten March 4–26, 1884, and sent to *Mind* on the 27th. On April 22, 1884, I received an invitation to come to Baltimore and read a paper before the Metaphysical Club of Johns Hopkins University, of which Dr. G. Stanley Hall was president. I had nothing ready but the rough draft of this paper, but I accepted the invitation and read the paper. This paper was reprinted entire in the *Cleveland Citizen*, under the title: "Mind as a Social Force."

Mind: a Quarterly Journal of Psychology and Philosophy, London, Vol. IX, No. 36, October, 1884, pp. 563–573; Reprint, p. 1–11; The Cleveland Citizen, Cleveland, Ohio, Vol. I, No. 4 [Old Series, Vol. IV, No. 104], Feb. 20, 1891, p. 1; No. 5 [105], Feb. 27, 1891, p. 1.

AFTER many centuries of exclusive study of the soul, the thinkers of the world turned their attention for some centuries more to the study of the intellect. During all this time, the true influence of mind as a social factor was left quite out of view. At last there rose up the scientific philosophy which essayed to explain the nature of mind. Its dependence upon organisation in general and upon brain in particular was proved by scientific experimentation, and the domain of metaphysics became that of psychology. Mind was shown to be a function of body and psychology became a department of biology. Man has now taken his true position in the animal world as a product of development. Brain, which alone raises him above other animals, has been developed in the same manner as the other anatomical characters. The brain is the organ of the mind, its physical seat and cause. Mind is therefore a natural product of evolution, and its achievements are to be classed and studied along with all other natural phenomena. Such is the scientific conception of mind.

The modern scientist places all objects in the midst of an infinite series of antecedents and consequents. Organic forms as well as inorganic must take their places in this series—the animal no less than the plant, the man no less than the beast. Mind itself is a link of this endless chain. Its activities consist in the transmission of the properties of its antecedents to its consequents. The quantity of force in the universe is constant. No power can increase or diminish it. All attempts on the part of the creatures of this constant and unchangeable force to modify its normal effects are not less vain because such creatures happen to have acquired the faculty of observing the changes going on in nature.

The protracted study of nature's processes leads to admiration of them, and the belief has become prevalent that they are not only unalterable but also in some way
564 necessarily beneficent. | Nature has made great pro-
[2] gress in developing organised beings and is assumed to
be still working in this direction. The natural method is always the true method, and to find it out is the aim of all scientific investigation. Out of this earnest and laudable

strife to discover the true method of nature has grown, logically enough, the assumption that when found it must be something of great worth. It is commonly supposed that the highest wisdom of man is to learn and then to follow the ways of nature. Those dissatisfied people who would improve upon the natural course of events are rebuked as meddlers with the unalterable. Their systems are declared utopian, their laws *bruta fulmina*. All efforts in this direction are held to be trifling and are stigmatised as so many ignorant attempts to nullify the immutable laws of nature.

This general mode of reasoning is carried into all departments of human life.

In government every attempt to improve the condition of the state is condemned and denounced. Curiously enough, here the claim is illogically made that such measures are harmful. In fact, unfortunately for the whole theory, they have often been proved to be so. But this, of course, proves their efficacy. This glaring inconsistency is, however, overlooked, and government is implored, not to adopt wise and successful measures, but to refrain from adopting any, to let society alone, and thus allow the laws of nature to work out their beneficent results.

In commerce and trade absolute freedom is insisted upon. Free trade is the watchword of this entire school. The laws of trade, they maintain, are natural laws. As such they must be better than any human rules. And here again we find them insisting that regulation is injurious to trade, although it is at the same time declared to be nugatory.

In social affairs these doctrines are carried to their extreme logical outcome. The laws of nature as they manifest themselves in society must be left wholly untouched. The passions of men will neutralise and regulate themselves. Competition can be depended upon to correct abuses. The seller must be allowed to exaggerate and misstate the nature of his wares. This has the effect to sharpen the wits of the buyer, and this develops the brain. To dilute, adulterate, or even poison food and medicine for personal gain is not objectionable, since the destruction thereby of a few unwary consumers only proves their unfitness to survive in society. As in general commerce, so in private business, competition must be free. If a dealer, by selling at a loss, can hold out until all his competitors have been driven from the field, in order then to recover more than his losses by the monopoly he will enjoy, his right to do this must not be questioned. It is under such conditions and by the aid of such discipline that man and society have developed.

Education must be that of experience. Knowledge must
565 be | gained by efforts to avoid the consequences of
[3] ignorance already felt. The intellectual development
of the child must be an epitome of that of the race. It is thus only that nature operates, and surely nature is greater and wiser than man.

All schemes of social reform are unscientific. Public charities tend to bolster up unworthy elements in society that nature has declared unfit to survive. Temperance reforms tend only to abridge individual liberty—for even the liberty to destroy one's self should be respected. Philanthropy is zeal without knowledge, while humanitarianism is fanaticism.

This general class of views antedated by many years the publication by Spencer and Darwin of their formulated doctrines of the "survival of the fittest" and "natural selection." But it cannot be denied that these doctrines, supported as they were by facts fresh from nature, have greatly strengthened this habit of thought. Nature's method is now much better known than formerly, and it is now well understood that an utterly soulless competition constitutes its fundamental characteristic. Surely man cannot go astray in following in the footsteps of nature. Let him learn from the animal world. He has descended from some of the humble stocks which he is now studying. Nature's plan has raised him from the condition of a beast to that of a rational being. It has created and developed society and civilisation. Unless tampered with by "reformers" all the operations of society would be competitive. Competition is the law of nature out of which progress results. Sociology, as its founder insisted, must be based on biology, and the true sociologist must understand this biologic law. Those who propose to apply methods to society which are opposed to the methods of nature are supposed to be ignorant of these fundamental truths and are called empiricists, "meddlers," and "tinkers".

Such, I say, is the tenor and tendency of modern scientific thought. I do not say that all scientific men hold these views. I merely maintain that leading ones have formulated and inculcated them as natural deductions from the established facts of science, and that the public mind is rapidly assimilating them, while scarcely any attempts are being made to check their advance.[1]

Is there any way of answering these arguments? Can the *laissez faire* doctrine be successfully met? That all attempts to do this have been timidly made cannot be denied. That these have been few and feeble is equally certain. While there has existed in the minds of many rational persons a
vague sense of | some hidden fallacy in all this reasoning, 566
none have felt competent to formulate their objections
with sufficient clearness and force to warrant pitting [4]
them against the resistless stream of concurrent science and philosophy of the nineteenth century. There has, however, been developing of late a more or less marked apprehension with regard to the possible consequences of this mode of thought. The feeling is distinct in the best minds, and to a large extent in the public mind, that the tendency of modern ideas is nihilistic. It is clear that if they become uni-

[1] The social philosophy of Mr. Herbert Spencer possesses this tone throughout, and his disciples, particularly in America, delight in going even farther than their master. The most extreme statement of the *laissez faire* doctrine known to me is that of Prof. W. G. Sumner, in his recent work *Social Classes*.

versally accepted they must work stagnation in society. The *laissez faire* doctrine is a gospel of inaction, the scientific creed is struck with sterility, the policy of resigning all into the hands of Nature is a surrender.

But this recognition is by no means proof that the prevalent opinions are false. At best it can only suggest this on the ground that true doctrines should be progressive. But this would be a *petitio principii*. Nature is not optimistic, still less anthropocentric. For aught we know, the laws of nature are such as make a recognition of strict scientific truth a positive barrier to social advancement. The argument we have been considering must be refuted, if at all, by legitimate counter-argument.

The present attempt to meet some parts of this argument is made in full consciousness of its strength as a factor in modern thought and with due deference to the great names that stand committed to it. The scientific facts which its defenders have brought to its support are, in the main, incontestable. To answer by denying these would be to abjure science and deserve contempt. The method of nature has been correctly interpreted. The doctrines of the survival of the fittest and natural selection are perfectly true doctrines. The law of competition is the fundamental law. It is unquestionably true that progress, not only in primary organic development, but also in society, has resulted from the action of this law.

After conceding all this, the attempt, notwithstanding, to stem the tide of modern scientific thought must, indeed, seem a hopeless one. At the outset it must be frankly acknowledged that if the current views are unsound the fault is not chargeable to science. If there is any defect it must lie in the inferences drawn from the facts and not in the facts themselves. To what extent, then, is the *laissez faire* doctrine, as defined and popularly accepted, an inference? If the method of nature is correctly formulated by that doctrine, wherein lies the fallacy when it is applied to man and to society?

In order to grapple at once with the whole problem let me answer these questions by the open charge that the modern scientific philosophers fail to recognise the true value of the *psychic factor.* Just as the metaphysicians lost their bearings by an empty worship of mind and made philosophy a plaything, so the modern evolutionists have missed their mark by degrading | mind to a level with mechanical force. They seem thus about to fling away the grand 567 results that the doctrine of evolution cannot otherwise [5] fail to achieve. Far be it from me to appeal to the prejudices of the enemies of science by casting opprobrium upon scientific deductions, but when I consider the tendencies which are now so unmistakable, and which are so certainly the consequence of the protracted study, on the part of leading scientists, of the unquestionable methods of nature, I think I can, though holding precisely opposite opinions, fully sympathise with Carlyle in characterising the philosophy of evolution as a "gospel of dirt".

But I need not longer dwell upon the blighting influence of this construction of the known laws of nature. Let us approach the kernel of the problem.

The *laissez faire* doctrine fails to recognise that, in the development of mind, a virtually *new power* was introduced into the world. To say that this has been done is no startling announcement. It is no more than has taken place many times in the course of the evolution of living and feeling beings out of the tenuous nebulæ of space. For, while it is true that nature makes no leaps, while, so long as we consider their beginning, all the great steps in evolution are due to minute increments repeated through vast periods, still, when we survey the whole field, as we must do to comprehend the scheme, and contrast the extremes, we find that nature has been making a series of enormous strides, and reaching from one plane of development to another. It is these independent achievements of evolution that the true philosopher must study.

Not to mention the great steps in the cosmical history of the solar system and of the earth, we must regard the evolution of protoplasm, the "physical basis of life," as one of those gigantic strides which thenceforth completely revolutionised the surface of our planet. The development of the cell as the unit of organisation was another such stride. The origin of vertebrate life introduced a new element, and the birth of man wrought still another transformation. These are only a few of nature's revolutions. Many more will suggest themselves. And although, in no single one of these cases can it be said at what exact point the new essence commenced to exist, although the development of all these several expressions of Nature's method of concentrating her hitherto diffused forces was accomplished through an unbroken series of minute transitional increments continued through eons of time, still, it is not a whit less true that each of these grand products of evolution, when at length fully formed, constituted a new cosmic energy, and proceeded to stamp all future products and processes with a character hitherto wholly unknown upon the globe.

It is in this sense, and in this only, that I claim the development of mind—of the thinking, reasoning, invent-
568 ing faculty of | the human brain—as another, and one
[6] of the best marked, of the great cosmic strides that have characterised the course of evolution and belong to the legitimate methods of nature.

It is, for example, only to a limited extent and in the most general way that we can apply the same canons to the organic as to the inorganic world. It is usually, but falsely, supposed that the student of biology need know nothing of physics, the assumption being that they have nothing in common. While this error is fatal to all fundamental acquaintance with the laws of life, it well illustrates the immensity of the advance from one realm to the other. The same could be said, in varying degrees of obviousness, of every one of the ascending steps to which reference has been made. I freely admit that the theologians and metaphysicians commit the most fatal error in treating the soul, or mind, as independent of the body, but this enormous fallacy is scarcely greater than that of the modern evolutionist, who, finding out their dependence, ignores the *magnitude* of the step by which mind was made a property of body, and proceeds as though no new factor had entered into the world.

But all this may be regarded as mere generality. Let us come to something more specific.

It has always been a marvel to my comprehension that wise men and philosophers, when smitten with the specious logic of the *laissez faire* school, can close their eyes to the most obtrusive fact that civilisation presents. In spite of the influence of philosophy, all forms of which have thus far been negative and nihilistic, the human animal, with his growing intellect, has still ever realised the power that is vouchsafed through mind, and has ever exercised that power. Philosophy would have long since robbed him of it and caused his early extermination from the earth but for the persistence, through heredity, of the impulse to exercise in self-preservation every power in his possession; by which practice alone he first gained his ascendancy ages before philosophy began.

The great fact, then, to which I allude is that in spite of all philosophy, whether mythologic, metaphysical, or naturalistic, declaring that man must and can do nothing, he *has*, from the very dawn of his intelligence, been transforming the entire surface of the planet he inhabits. No other animal performs anything comparable to what man performs. This is solely because no other possesses the developed psychic faculty.

If we analyse mind into its two departments, sense and intellect, we shall see that it is through this latter faculty that these results are accomplished. If we inquire more closely into the mode by which intellect operates, we shall find that it serves as a guiding power to those natural forces with which it is acquainted (and no others), directing them

into channels of human advantage. If we seek for a single term by which to characterise with precision the nature
569 of this process, we find this in *Inven* | *tion.* The essen-
[7] tial characteristic of all intellectual action is invention.

Glancing now at the *ensemble* of human achievement, which may be collectively called civilisation, we readily see that it is all the result of this inventive process. All practical art is merely the product of successful invention, and it requires no undue expansion of the term, nor extraordinary power of generalisation, to see in all human institutions only modified forms of arts, and true products of the intellectual, or inventive, faculty.

But what is the general result of all this? An entirely new dispensation has been given to the world. All the materials and forces of nature have been thus placed completely under the control of one of the otherwise least powerful of the creatures inhabiting the earth. He has only to know them in order to become their master. Nature has thus been made the servant of man. Thus only has man succeeded in peopling the entire globe while all other animals are restricted to narrow faunal areas. He has also peopled certain portions far more densely than any other species could have done, and he seems destined to continue multiplying his numbers for a long time yet in the future. But this quantitative proof is even less telling than the qualitative. When we confine our attention to the *élite* of mankind we do not need to have the ways specified in detail by which the powers of mind have exalted the intellectual being above all other products of creation. At the present moment the most dense and the most enlightened populations of the globe occupy what are termed temperate latitudes, which means latitudes in which for from three to five months each year vegetation ceases entirely, the waters are locked in ice, and the temperature frequently sinks far below the zero of the Fahrenheit thermometer. Imagine the thin-skinned, furless animal man subsisting in such a climate. Extinguish his fires, banish his clothing, blot out the habitations that deck the civilised landscape. How long would the puny race survive? But these are not products of nature, they are products of *art*, the wages of thought—fruits of the intellect.

When a well-clothed philosopher on a bitter winter's night sits in a warm room well lighted for his purpose and writes on paper with pen and ink in the arbitrary characters of a highly developed language the statement that civilisation is the result of natural laws, and that man's duty is to let nature alone so that untrammeled it may work out a higher civilisation, he simply ignores every circumstance of his existence and deliberately closes his eyes to every fact within the range of his faculties. If man had acted upon his theory there would have been no civilisation, and our philosopher would have remained a troglodyte.

But how shall we distinguish this human, or anthropic, method from the method of nature? Simply by reversing all the definitions. Art is the antithesis of nature. If we call one the natural | method we must call the other
the artificial method. If nature's process is rightly 570
named natural selection, man's process is artificial [8]
selection. The survival of the fittest is simply the survival of the strong, which implies, and might as well be called, the destruction of the weak. And if nature progresses through the destruction of the weak, man progresses through the *protection* of the weak. This is the essential distinction.

In human society the psychic power has operated to secure the protection of the weak in two distinct ways: first, by increasing the supply of the necessities of life, and, secondly, by preventing the destruction of life through the enemies of man. The immediate instrumentality through which the first of these processes is carried on is art, the product of invention. The second process takes place through the establishment of positive institutions.

It is difficult to say which of these agencies has been most effective. Both were always indispensable, and therefore all comparison is unprofitable.

Art operates to protect the weak against adverse surroundings. It is directed against natural forces, chiefly physical. By thus defeating the destructive influences of the elements and hostile forms of life, and by forcing nature to yield an unnatural supply of man's necessities, many who would have succumbed from inability to resist these adverse agencies—the feebler members of society—were able to survive, and population increased and expanded. While no one openly denies this, there is a tendency either to ignore it in politico-economic discussions, or to deny its application to them as an answer to naturalistic arguments.

If, on the other hand, we inquire into the nature of human institutions, we shall perceive that they are of three kinds, tending to protect the weak in three ways, or ascending degrees. These three successively higher means through which this end is attained are, first, Justice, second, Morality, and third, Charity. These forms of action have been reached through the development, respectively, of the three corresponding sentiments: Equity, Beneficence, and Benevolence.

All of these altruistic sentiments are wholly unknown, or known only in the merest embryo, to all animals below man, and therefore no such means of protection exist among them. They are strictly human, or anthropic. Many evolutionists fail to recognise this. Some sociologists refuse to admit it. They look about and see so much injustice, immorality and rapacity that they are led to suppose that only natural methods are in operation in society. This is a great mistake. In point of fact, the keener the sense of justice the more conspicuous the diminishing number of violations of it come to appear, and conversely, the obviousness of injustice proves the general prevalence of justice. It is the same with morality and philanthropy.

If we consider the effect of these three codes of human con | duct in the direction of enabling the weaker ones to survive we shall see that it has been immense. Out 571
of the first has arisen government, the chief value and [9]
function of which has always been and still is such protection. Great systems of jurisprudence have been elaborated, engrossing the attention of a large portion of the population of enlightened as well as of barbaric states. To say that these have been failures because often weighted with grave defects is to misinterpret history and misunderstand society. No one could probably be found to gainsay that the moral law of society has exerted a salutary influence, yet its aim is strictly altruistic, opposed to the law of the survival of the fittest, and wholly in the direction of enabling those to survive who would not survive without its protection. Finally, the last sentiment to be developed, and doubtless the highest, is so universally recognised as peculiar to man that his very name has been given to it—the sentiment of *humanity*. Yet the mode of protecting the weak arising out of this sentiment is the one that has been most seriously called in question by the naturalistic school. It must be admitted that humanitarian institutions have done far less good than either juridical or ethical institutions. The sentiment itself is of recent origin, the product only of highly developed and greatly refined mental organisation. It exists to an appreciable degree only in a minute fraction of the most enlightened populations. It is rarely directed with judgment; no fixed, self-enforcing code of conduct, as in the other cases, having had time to take shape. The institutions established to enforce it are for the most part poorly supported, badly managed, and often founded on a total misconception of human nature and of the true mode of attaining the end in view. Hence they are specially open to attack. But if ever humanitarian sentiments become diffused throughout the body politic, become the object of deep study, as have those of justice and right, it may be confidently predicted that society will prove itself capable

of caring for the most unfortunate of its members in a manner that shall not work demoralisation.

In all these ways man, through his intelligence, has laboured successfully to resist the law of nature. His success is conclusively demonstrated by a comparison of his condition with that of other species of animals. No other cause can be assigned for his superiority. How can the naturalistic philosophers shut their eyes to such obvious facts? Yet, what is their attitude? They condemn all attempts to protect the weak, whether by private or public methods. They claim that it deteriorates the race by enabling the unfit to survive and transmit their inferiority. This is true only in certain cases of hereditary diseases or mental deficiencies, which should be taken account of by man because they are not by nature. Nothing is easier than to show that the unrestricted competition of nature does not secure the survival of the fittest possible, but only
of the actually fittest, and | in every attempt man
572 makes to obtain something fitter than this actual
[10] fittest he succeeds, as witness improved breeds of
animals and grafts of fruits. Now, the human method of protecting the weak deals in some such way with men. It not only increases the number but improves the quality.

But "government," at least, must *laisser faire*. It must not "meddle" with natural laws. The laws of trade, business, social intercourse, are natural laws, immutable and indestructible. All interference with them is vain. The fallacy here is a ***non sequitur***. It may be readily granted that these laws are immutable and indestructible. Were this not the case it would certainly be hopeless to interfere with their action. But every mechanical invention proves that nothing is easier than to interfere successfully with the operation of these uniform natural forces. They have only to be first thoroughly understood and then they are easily *controlled*. To *destroy* a force is one thing, to control its action is quite another. Those who talk in this way involve themselves in the most palpable inconsistency. They must not be allowed to stop where they do. They must go on and carry their strictures to a logical conclusion. They must deny to government the right to protect its citizens from injustice. This is a clear interference with the natural laws of society. They must deny to society the right to enforce its code of morals. Nothing is more unnatural. They must suppress the healing art which keeps the sick from dying as they do among animals. Nor is this all. They must condemn all interference with physical laws and natural forces. To dam a stream must be characterised as a "vain" attempt to overcome a natural law. The wind must be left free to blow where it will, and not be forced against the fan of a wind-mill. The vapour of heated water must be allowed to float off naturally into the air and not be pent up in a steam-boiler and thence conducted into the cylinder of a steam-engine. All these things and every other device of inventive man are so many attempts to "violate" the laws of nature, which is declared impossible.

What then remains of the *laissez faire* doctrine? Nothing but this: That it is useless, and may be dangerous, to attempt to control natural forces until their character is first well understood. This is a proposition which is true for every department of force, and does not involve the surrender of the whole domain of sociology after it has been demonstrated that society is a theatre of forces.

The truth thus comes forth from a rational study of nature and human society that social progress has been due only in very slight degree to natural evolution as accomplished through the survival of the fittest, and its chief success has resulted from the reduction of competition in the struggle for existence and the protection of the weaker members. Such competition, in so far as it has been permitted to operate, has tended to lower the | standard
of the fittest and to check advancement. It is not, of 573
course, claimed that the natural method has ever been [11]
fully overcome. It has always operated, and still operates, powerfully in many ways. It has been chiefly in the simpler

departments of physical and mechanical phenomena that the psychic, or anthropic, method has superseded it. The inventive arts have been the result. Vital forces have yielded to some extent to the influence of mind in bringing about improved stocks of animals and vegetables, and even certain social laws have come under rational control through the establishment of institutions. Still, every step in this progress has been contested. It was not enough that the intellect was feeble and ill-fitted to grapple with such problems. It was not enough that ignorance of nature's laws should cause unnumbered failures. A still stronger barrier was presented by the intellect itself in the form of positive error embodied in philosophy. As already remarked, philosophy has always been negative and nihilistic, and has steadily antagonised the common sense of mankind. It is only quite recently that there has come into existence anything like a truly *positive* philosophy, *i. e.*, a philosophy of *action.* The intellectual power of enlightened man has at length become sufficient to grasp the problems of social life. A large body of truth has been accumulated by which to be guided in their solution. Positive error in the drawing of false conclusions from established facts is now the chief obstacle. Rational interpretation has come to prevail in all the lower departments of phenomena. It is chiefly in the complex departments of psychic and social action that error still holds sway. Nothing remains to be done but to apply the established canons of science to these higher fields of activity. Here there is still competition. Here the weaker still go to the wall. Here the strong are still the fittest to survive. Here Nature still practises her costly selection which always involves the destruction of the defenceless. The demand is for still further reduction of competition, still greater interference with the operations of natural forces, still more complete control of the laws of nature, and still more absolute supremacy of the psychic over the natural method of evolution.

These ends will be secured in proportion as the true nature of mind is understood. When nature comes to be regarded as passive and man as active, instead of the reverse as now, when human action is recognised as the most important of all forms of action, and when the power of the human intellect over vital, psychic and social phenomena is practically conceded, then, and then only, can man justly claim to have risen out of the animal and fully to have entered the human stage of development.

180. The Fossil Flora of the Globe[1]

History.—This paper consists of the three abstracts that I prepared of my papers read before the Biological Section of the American Association for the Advancement of Science at the Philadelphia Meeting in 1884 (see Nos. **192, 193, 194**, *infra*, pp. 427, 430, 432), with the addition of the table, which does not appear in the Proceedings. I had sent on the abstracts as required, some time in advance of the meeting. Prof. J. C. Arthur, representing the *Botanical Gazette*, was there early and had been permitted to copy the abstracts. I saw him, and he told me he had done so. How he came by the table I do not know. I suppose I must have given it to him then and there. (See No. **142**, *supra*, p. 129; No. **909**; No. **208**.)

Botanical Gazette, Indianapolis, Vol. IX, Nos. 10 & 11, October and November, 1884, pp. 169–174.

HISTORICAL VIEW.—The writers of antiquity make no mention of any form of vegetable petrification. The earliest allusion to the sub-

[1] Abstract, prepared by the author, of a paper read before the A. A. A. S., Philadelphia, 1884.

ject was made by Albertus Magnus in the thirteenth century. Agricola and Gesner treated of petrified wood in the sixteenth century. The first mention of any kind of vegetable impression in the rocks was made by Daniel Major, of Jena, in 1664. In 1699 Edward Lhwyd, of London, wrote an extensive treatise on such impressions. He maintained that they were the remains of plants that had perished in the Noachian deluge. In 1709 Scheuchzer, of Switzerland, defended this view in his "Herbarium Diluvianum," a large work, in which he described and figured many fossil plants, referring them to species living in Europe. In 1718 this author went so far as to classify the fossil plants according to the system of Tournefort. In 1723 he published a new edition of the "Herbarium Diluvianum" into which he introduced this classification, and enumerated 445 species. A powerful reaction against this method followed; comparisons with living plants were carefully made, which failed to establish the identity of the fossils. The idea of their exotic origin was thereupon suggested, and for a time prevailed, but towards the close of the eighteenth century this in turn gave way to the true view of the existence of the former geologic periods with floras of their own differing from that of the present. Baron von Schlotheim headed this new school, and was followed by Count Sternberg and Adolphe Brongniart, who jointly founded the science of vegetable paleontology in the first quarter of the present century.

The first attempt to place it upon the footing of a systematic | science was made by Rev. Henry Steinhauer, 170
of Bethlehem, Pennsylvania, in a paper read before the American Philosophical Society, and published in its "Proceedings" for the year 1818. In this paper he described and figured ten species of Waller's genus *Phytolithus*, which was made to embrace nearly all forms of vegetable fossils. Two years later Schlotheim, in his "Petrefactenkunde," applied specific names to 78 fossil plants. Brongniart, in his "Prodrome," published in 1828, went much

farther. He referred many fossil plants to living genera, and created a large number of new extinct genera. He enumerated 501 species, many of which were fully characterised and thoroughly illustrated in his "Histoire des Végétaux Fossiles."

A census of fossil plants was taken by Unger in 1845, which showed that the number of known species had increased to 1,648. In 1848, Göppert made a similar enumeration, and found 2,055 species. The extraordinary activity that followed in the developing of new fossil floras rendered it possible for Schimper, in 1874, to describe about 6,000 species in his great work, "Traité de Paléontologie Végétale." The decade which has elapsed since the appearance of that work has witnessed extensive investigations in this field, particularly in the arctic regions and in the United States, and the number of fossil species now known to science is probably between eight and nine thousand.

Geological View.—The most ancient vegetable remains known are two species of *Oldhamia* from the Cambrian of Ireland. From the Lower Silurian 44 species, chiefly marine algæ, have been named. Among these, however, are included the earliest terrestrial forms, viz., *Eopteris Morierei*, Sap., *Sphenophyllum primævum*, Lx., and two other vascular plants from the Cincinnati Group. Of the 13 species of the Upper Silurian, five are vascular plants, and these include *Cordaites Robbii*, Dawson, from Hérault. The Devonian furnishes 188 species of fossil plants, in which ferns play the leading rôle, while from Permo-Carboniferous strata nearly two thousand species are known. Only 67 species are found in the whole of the Trias. With the Rhetic a new impulse is felt increasing to the Oölite, in which 419 species occur. The Upper Jurassic and Lower Cretaceous are sparingly supplied with the remains of vegetation, but in the Cenomanian, to which the beds of Atane, Greenland, and our own Dakota Group of Kansas and Nebraska are referred, nearly 500 species of

fossil plants have already been found. The Turonian, with its probable equivalent in the west, the Fort Benton Group, is | nearly destitute of vegetable remains, but 171
the Senonian immediately overlying it, with which the Canadian geologists have correlated certain rich plant beds of British Columbia, and to which Heer's flora of Patoot, Greenland, must be referred, yields more than 350 species. The Laramie Group of the western United States is thought to be extreme Upper Cretaceous. This is very rich in plants, and 333 species have already been described from this horizon.

The Tertiary flora is much more abundant than even that of the Carboniferous. The Eocene furnishes nearly 800 species (including our Green River Group and the Paleocene beds of Sézanne and Gelinden). The Oligocene of Europe yields a somewhat larger number. The maximum is attained in the Miocene, from which more than three thousand fossil plants are known. The Miocene practically closes the geological series so far as vegetable paleontology is concerned. Only about 150 Pliocene species exist, and a still smaller number from the Quaternary.

Botanical View.—I. First appearance of types.

The Oldhamias of the Cambrian, mentioned in the last paper, are classed as marine algæ of the order *Florideæ*. The ferns, *Equisetineæ*, and *Lycopodineæ* all appeared in the Lower Silurian. One species of *Cordaites*, which is now regarded as the ancestral type of *Coniferæ*, occurs in the Upper Silurian. The *Rhizocarpeæ*, according to Dawson, existed in the Devonian of Canada and Brazil.

The *Cycadaceæ* and the Monocotyledons have their earliest known representatives in the Carboniferous. The order *Gnetaceæ* is represented, according to Heer, in the Oölite of Siberia by his species *Ephedrites antiquus*. The Dicotyledons first appear in the Urgonian of Kome, Greenland, through Heer's single species *Populus primæva*. All three of the divisions of dicotyledonous plants occur in great abundance in the Cenomanian. If the genus *Selagin-*

ella is regarded as belonging to the *Ligulatæ*, this small transitional type also first appears in the Cenomanian, at Atane, Greenland.

All the leading types of vegetation are thus introduced without going later down the geological scale than the middle Cretaceous.

II. Age of maximum relative predominance of each type.

The marine algæ, of course, being the only vegetation, were supreme during the Cambrian and early Silurian. The maximum relative predominance of each of the other principal types was reached as follows: The ferns in
172 the Permian, the *Equiset* | *ineæ* and the *Lycopodineæ* in the Carboniferous, the *Cycadaceæ* in the Lias or Oölite, the *Coniferæ* in the Wealden or Neocomian, the Monocotyledons in the Eocene, the monochlamydeous Dicotyledons in the Cenomanian, the polypetalous Dicotyledons in the Miocene, and the gamopetalous Dicotyledons in the present living flora of the globe.

III. Probable true period of origin and of maximum absolute development of each type.

173 | Cellular Cryptogams of some kind probably lived in the Laurentian, and account for the graphite beds and dark carbonaceous matter of certain Archæan rocks. Being an heterogeneous group their later representatives belonged to entirely different families. If we include the fungi the number of species is probably greater in the living flora than it was at any geological epoch. The ferns, *Equisetineæ*, and *Lycopodineæ* probably all originated in the
174 Lower Silurian, and reached their absolute maximum in the Carboniferous. The *Cycadaceæ* may have originated as early as the Devonian. They must have attained their absolute as well as their relative maximum development in the middle Jurassic. The *Coniferæ* through their archaic form, the *Cordaiteæ*, began in the Lower Silurian. They attained their full maturity in the Cretaceous, and are now on the decline. The Monocotyledons

probably date back to the Lower Carboniferous or Devonian, and reached their highest expression in the palms whose reign occupied the early Tertiary. These also are probably now waning. The Dicotyledons must have had their real origin in the Lower Jura or Upper Trias; their absolute probably coincides with their relative development, the *Apetalæ* being now declining, the *Polypetalæ* about stationary, and the *Gamopetalæ* rapidly advancing.

2

Number of Species of each of the Principal Types of Vegetation that have
time, as nearly as it is possible to ascertain, together with the perce

	Geological Formations.	Cryptogams.										
		Cellular.		Vascular.								
				Ferns.		Rhizocarpeæ.		Equisetineæ.		Lycopodineæ.		Ligula
		No.	p. c.	No.	p. c.	No.	p. c.	No.	p. c.	No.	p. c.	No.
	Present time	35,000	23.89	3,000	2.05	100	0.07	30	0.02	500	0.34	400
	Quaternary	27	33.3	4	4.9	......	......	2	2.5	......	......	......
Tertiary.	Amber	37	55.2	......	......	......	......	......	......	......	......	......
	Pliocene	......	......	3	3.1	......	......	......	......	......	......	......
	Miocene	138	5.5	87	2.9	6	0.2	18	0.6	......	......	2
	Oligocene	17	2.2	17	2.2	1	0.1	3	0.4	......	......	......
	Green River	5	2.2	8	3.5	2	0.9	3	1.3	1	0.4	1
	Eocene	71	10.3	22	3.2	......	......	1	0.2	......	......	......
	Paleocene	3	2.5	7	5.9	......	......	......	......	......	......	......
Cretaceous.	Laramie	13	3.9	23	6.9	1	0.3	4	1.3	1	0.3	3
	Senonian	23	6.5	73	20.6	......	......	1	0.3	......	......	......
	Turonian	1	20.0	1	20.0	......	......	......	......	......	......	......
	Cenomanian	8	3.3	38	15.5	1	0.4	1	0.4	......	......	1
	Dakota	1	0.5	7	3.3	......	......	......	......	......	......	......
	Gault	......	......	10	27.8	......	......	......	......	......	......	......
	Urgonian	......	......	50	46.3	1	0.9	3	2.8	1	0.9	......
	Neocomian	10	25.6	12	30.8	......	......	......	......	......	......	......
Jurassic.	Wealden	7	5.8	44	36.4	......	......	......	......	......	......	......
	Coral	19	29.2	12	18.4	......	......	......	......	......	......	......
	Oölite	39	9.3	133	31.7	1	0.3	14	3.3	3	0.7	......
	Lias	13	9.7	44	32.8	......	......	4	3.0	......	......	......
	Rhetic	8	6.3	69	54.3	......	......	5	3.9	......	......	......
Trias.	Keuper	......	......	15	36.6	......	......	3	7.3	......	......	......
	Muschelkalk	2	33.3	1	16.7	......	......	......	......	......	......	......
	Bunter Sandstein	......	......	7	31.9	......	......	1	4.5	......	......	......
	Permian	6	1.8	186	55.4	......	......	26	7.7	9	2.7	......
	Carboniferous	17	1.2	627	42.4	......	......	143	9.7	368	24.9	......
	Sub-carboniferous	5	3.7	64	47.4	1	0.8	20	14.8	25	18.5	......
	Devonian	33	17.6	79	42.0	3	1.6	16	8.5	28	14.9	......
	Upper Silurian	8	61.5	2	15.4	......	......	1	7.7	1	7.7	......
	Lower Silurian	40	90.9	1	2 3	......	......	1	2.3	2	4.5	......
	Cambrian	2	100.0	......	......	......	......	......	......	......	......	......

Fossil in each Geological Formation; also, the number existing at the present ...ach type forms of the total flora of each formation.

PHÆNOGAMS.													
GYMNOSPERMS.					ANGIOSPERMS.								TOTAL.
							DICOTYLEDONS.						
...aceæ.	Coniferæ.		Gnetaceæ.		MONO-COTYLEDONS.		Apetalæ.		Polypetalæ.		Gamopetalæ.		
p. c.	No.	p. c.	No.	p. c.	No.	p. c.	No.	p. c.	No.	p. c.	No.	p. c.	
0.05	300	0.24	40	0.03	20,000	13.65	12,000	8.19	35,000	23.89	49,000	27.31	146,445
2.5	4	4.9	......	......	......	......	27	33.3	8	9.9	7	8.7	81
......	14	20.9	1	1.5	2	3.0	5	7.5	1	1.5	7	10.4	67
......	13	13.3	......	......	9	9.2	32	32.6	31	31.6	10	10.2	98
0.2	250	8.2	1	0.04	272	8.9	826	27.1	1,064	35.0	346	11.3	3,046
0.3	64	8.3	1	0.1	82	10.6	256	33.1	259	33.6	70	9.1	772
......	10	4.4	......	......	21	9.2	85	37.1	73	31.9	20	8.7	229
0.4	34	4.9	......	......	116	16.8	162	23.5	221	82.	59	8.6	689
......	1	0.8	......	......	7	5.9	57	47.9	39	32.8	5	4.2	119
0.3	15	4.5	......	......	33	9.9	125	37.5	84	25.2	30	9.0	333
1.4	34	9.6	......	......	18	5.1	118	33.3	64	18.1	18	5.1	354
......	1	20.0	......	......	......	......	......	......	2	40.0	......	......	5
4.5	28	11.4	......	......	6	2.5	61	25.0	82	33.7	7	2.9	244
3.3	12	5.6	......	......	5	2.4	88	41.3	84	39.4	9	4.2	213
5.5	22	61.2	......	......	2	5.5	......	......	......	......	......	......	36
19.4	25	23.2	......	......	6	5.6	1	0.9	......	......	......	......	108
15.4	9	23.1	......	......	2	5.1	......	......	......	......	......	......	39
35.5	26	21.5	......	......	1	0.8	......	......	......	......	......	......	121
26.2	17	26.2	......	......	......	......	......	......	......	......	......	......	65
27.7	103	24.6	1	0.3	9	2.1	......	......	......	......	......	......	419
43.3	10	7.5	......	......	5	3.7	......	......	......	......	......	......	134
20.5	18	14.2	......	......	1	0.8	......	......	......	......	......	......	127
36.6	7	17.1	......	......	1	2.4	......	......	......	......	......	......	41
......	3	50.0	......	......	......	......	......	......	......	......	......	......	6
13.6	7	31.8	......	......	4	18.2	......	......	......	......	......	......	22
4.1	92	27.4	......	......	3	0.9	......	......	......	......	......	......	336
0.5	307	20.8	......	......	8	0.5	......	......	......	......	......	......	1,478
......	20	14.8	......	......	......	......	......	......	......	......	......	......	135
......	29	15.4	......	......	......	......	......	......	......	......	......	......	188
......	1	7.7	......	......	......	......	......	......	......	......	......	......	13
......	......	......	......	......	......	......	......	......	......	......	......	......	44
......	......	......	......	......	......	......	......	......	......	......	......	......	2

181. [Fish-Culture as an Example of Successful State Action]

History.—Remarks on the paper of Prof. G. Brown Goode on "The Aims and Limitations of Modern Fish-Culture," read Feb. 8, 1884.

Proceedings of the Biological Society of Washington, Washington, D. C., Vol. II, 1885, pp. XLIX–L.

PROF. L. F. WARD remarked that he had been interested in the paper especially on account of the broad general principles in political economy which had been shown to underlie the subject discussed; that the lessons which the United States, by means of its participation in the London Fisheries Exhibition and its successes in the field of fish-culture, had taught to Europe, and especially to Great Britain, were of great importance. Political economists of the Manchester school need to be shown in just such a way as this that the policy of State
L con | trol and management for large enterprises, involving large outlays of money, is the only policy which can be successfully carried out.

182. Why is Water Considered Ghost-Proof?

History.—Written Dec. 20, 1884, upon the impulse after reading the address referred to.

Science, Cambridge, Massachusetts, Vol. V, No. 100, Jan. 2, 1885, p. 2.

AS a possible partial explanation of the fact referred to by Dr. Edward B. Tylor, in his address before the Anthropological society of Washington (see *Science*, IV, 548, col. 2), of the wide spread belief among savages "that water is impassable to spirits," the obstacle which it presents to dogs in pursuing their prey by scent may be suggested. This latter fact must be well known to most uncivilized races; and the mystery of tracking by scent must furnish a fertile theme for the exercise of the savage imagination, while the scent itself of a human being would be readily attributed to his spirit. Can anthropologists show any "historical connection" between the fact and the belief?

January 30, 1885—Ætat. 43.

183. A Glance at the History of Our Knowledge of Fossil Plants *

History.—This is the first of the three papers that I read before the Biological Section of the American Association for the Advancement of Science at the Philadelphia Meeting, and is the paper in full. It was there entitled: "Historical View of the Fossil Flora of the Globe." It was written Aug. 21–23, 1884, and read from the original draft. It was rewritten Oct. 18th–30th, but not materially altered. This represents the final draft. I offered all three of the papers to *Science* on November 24th, but only the first was accepted. The copy, which was returned to me, and which I still possess, shows that the title I gave for the whole series was simply: "On the Fossil Flora of the Globe," which is stricken out and the present title substituted. For the abstract see No. **180**, supra, p. 378, and Nos. **192–194**, infra, pp. 427–432. See also No. **142**, supra, p. 129, and No. **208**.

Ibid., No. 104, January 30, 1885, pp. 93–95.

* Read before the American Association for the Advancement of Science, Sept. 8, 1884.

THE ancients, though acquainted with fossil shells and corals, were wholly ignorant of fossil plants; and the first mention of any vegetable substance in a state of petrifaction was made by Albertus Magnus about the middle of the thirteenth century. Agricola, Gesner, and others treated of petrified wood in the sixteenth century; and, during the seventeenth, Major in Germany, and notably Lhwyd in England, called attention to the existence of vegetable impressions in the rocks. By the beginning of the eighteenth century considerable collections of such material existed in the European museums, and this had become the subject of animated discussion. Dendrite had long been known, and was then generally supposed to represent vegetable matter; but in the year 1700 Scheuchzer overthrew that doctrine, and established its purely mineral character.

Prior to this date the prevailing notions of the times ascribed all fossils to some mysterious cause, and denied their reality as the remains of things that had once possessed life. As to their true nature there was, however, no harmony of opinion. Some looked upon them as divinely created archetypes of living things, others as divine enigmas placed before man to test his faith, others still as merely the varied forms of the subterranean world corresponding to those of the earth's surface, while many regarded such objects as purely accidental, or as mere freaks of nature.

Against these predominant mystic views there had, however, long existed the theory that these forms, so strikingly similar to real things, might be the petrified remains of the life that perished by the Noachian deluge, and which had been stranded on the mountains and highlands of Europe and Asia. This view was countenanced by Martin Luther, and strongly defended by Alexander ab Alexandro in the sixteenth century; while towards the close of the seventeenth it secured many earnest advocates, including Woodward of England, and Scheuchzer of Switzerland. The latter undertook to defend his theory from the evidence furnished by plant-remains; and from this zeal resulted his greatest work, one of the most remarkable of the time,—his "Herbarium diluvianum." This appeared in 1709, and in it are enumerated and figured many fossil plants. These impressions were declared to be those of existing and often familiar species; and we find among them the myrrh of Scripture, Galium, Hippuris, and other well-known forms. So confident was Scheuchzer that these were living plants, that in 1718 he ventured to classify all known impressions according to Tournefort's system, as drawn up in his "Elémens de botanique" in 1694. The new edition of the "Herbarium diluvianum," which appeared in 1723, contained this systematic table, in which four hundred and forty-five species are enumerated.

This bold stroke aroused an intense interest in the subject, and immediately led to a closer comparison of the fossil with the living flora. In this work, Leibnitz in 1706, and Antoine de Jussieu in 1718, had already led the way by examining certain well-defined impressions, and expressing strong doubts of their identity with any European species. Further investigations were made; and these disagreements soon gave rise to the belief that they were tropical forms which by some convulsion or vicissitude had been brought to Europe, and buried under its soil. This view prevailed until the close of the eighteenth century.

Thus far the idea of ancient or extinct life had
94 | scarcely been conceived; but continued failure to correlate fossil with living forms, even after thorough examination of many tropical floras, began to give importance to this question, and in the first year of the present century Baron von Schlotheim commenced to urge for plants, what Blumenbach had for some years insisted upon for animals, that the fossil forms were extinct, and belonged to another age of the world, characterized by a different kind of life. Hard as this doctrine then was for the beliefs of the times, its manifest soundness caused it steadily to gain ground,

and soon opened the way for the serious study of paleontology on a true scientific basis.

The reaction against attempting to correlate fossil with living plants went too far, and the former nomenclature was completely abandoned. Judging all by the paleozoic forms, which had been the chief objects of study, all efforts to apply generic names even to those of the most recent formations were suspended, and resort was had to the terminologies of the mineralogists, particularly those of Waller, Walch, and Schröter. All vegetable remains were called phytolithes. Impressions on the rocks were distinguished as phytotypolithes. Fossil leaves were named bibliolithes, and fossil fruits carpolithes. Not until 1818 did any one venture to establish species under any of these heads. The first attempt of this nature was made in that year by the Rev. Henry Steinhauer, whose now celebrated memoir, "On fossil reliquia of unknown vegetables in the coal strata," describes and figures ten species of Phytolithus, assigning to each an appropriate specific name. This may be regarded as the true birth of systematic paleobotany,—an example of the humility of true science as contrasted with the arrogant assumptions of Scheuchzer a century before.

It is remarkable that this initial paper by Steinhauer was published in an American serial, the Proceedings of the American Philosophical Society, at Philadelphia, and was contributed by an American citizen, and member of that society. But that it was founded on any extensive study of the coal-plants of this country, as some have stated, there is no internal evidence. No American localities are mentioned; and the paper seems to deal throughout with British fossils and British coal-mines, with which the author was perfectly familiar.

Schlotheim, who in his "Flora der Worwelt," 1804, had not dared to go thus far, took a step in advance, two years later, in his "Petrefactenkunde." He greatly enriched the terminology of the science, and described with true binomial designations seventy-eight species belonging to seven genera of fossil plants.

Count Sternberg's "Flora der Vorwelt" commenced to appear in parts at about this time, in which many new genera were created on thoroughly studied grounds; and in 1822 Adolphe Brongniart's elaborate paper on the classification of fossil plants was published in the memoirs of the Paris museum of natural history. But these contributions, though highly systematic, and by far the most important that had been made to the science, did not descend to the question of species, nor indicate the number of distinct forms. The next work, therefore, in which light is thrown upon this problem, was Brongniart's "Prodrome," which appeared in 1828. By this time the science of paleontology had been fairly established, and geognostic considerations had come to receive something like their due weight. The ancient floras were distinguished from the later ones, and the approaching analogy of the latter to that of our own time was clearly perceived by Brongniart, who thus early prophetically declared for the successive development of higher types, though this view was strenuously opposed by the English school a decade later.

In this work, and the large treatise published the same year ("Histoire des végétaux fossiles"), to which it forms an introduction, an immense advance was effected in the systematic treatment of fossil plants. Not only was a large number of species recognized, belonging to the extinct genera heretofore established, and many new genera created, but the identity of many of the fossil with living genera was boldly asserted, at least for the more recent formations; and a long step was taken in the direction of correlating the extinct and living floras, and of demonstrating the fact of an uninterrupted series connecting the past with the present plant-life of the globe.

At that date Brongniart enumerates five hundred and one species of fossil plants, nearly half of which belonged to the first, or oldest, of his four periods, corresponding to the paleozoic of modern geologists, and of course chiefly from the coal-measures.

It is interesting to note here how much faster the science of fossil plants has advanced in this numerical respect than that of botany proper; for, while more than a hundred living species were then known to Brongniart for every fossil species, only eighteen living plants are now known to one fossil plant. And yet how rapid has been the growth of our knowledge in both sciences may be realized by contemplating the fact that nearly five times as many living, and sixteen times as many fossil, plants are recognized now as then.

A census of fossil plants was again taken in 1845, by Unger, in his "Synopsis plantarum fossilium," in which he enumerates 1,648 species; and in the same year, by Göppert, quite independently of the former work, in a paper published in Leonhard and Bronn's "Neues Jahrbuch für Mineralogie," in which 1,778 species are claimed. Sixty-eight thousand living species were then known to Göppert, or about thirty-eight living to one fossil species.

In 1849 Göppert again reviewed the fossil flora, and published an exhaustive enumeration in Bronn's "Index palaeontologicus." He now finds 2,055 fossil species, to be compared with the 69,403 living species named in the same work, or less than thirty-five living to one fossil species.

The third quarter of the present century was one of intense activity for systematic vegetable paleontology. The combined labors of Heer, Saporta, Ettingshausen, and Lesquereux, with a large corps of | co-laborers working
upon abundant material from all parts of Europe, 95
from the arctic regions, and from the United States, multiplied several times within a few years the number of fossil plants known to science; so that by the time of the completion of Schimper's "Traité de paléontologie végétale," in 1874, he found that he had been able to describe in that work about six thousand good species, after a liberal exclusion of uncertain forms. But a thorough inspection

of this important work shows that even then he came far short of gathering in all the data extant at that date, while it is since then that most of the solid work in this line has been done in America and in the polar districts.

A catalogue of all the fossil plants that have been described, down to the present year, is in preparation at the National museum; and, though still far from complete, the work has sufficiently progressed to warrant an approximate estimate of the present number of species, which cannot fall far short of nine thousand, and may considerably exceed that figure.

184. Administrative Report to the Director of the United States Geological Survey for the Year Ending June 30, 1882

History.—Written (dictated) Aug. 17, 1882. Although dated 1883, this report did not appear until February, 1885.

Third Annual Report of the United States Geological Survey, 1881–'82. Washington, 1883, pp. 26–29.

REPORT OF MR. LESTER F. WARD.

UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., August 17, 1882.

SIR: I have the honor to report that from July 1 until July 26, 1881, I was principally engaged in collecting the titles of works on vegetable paleontology for the Survey.

On July 26, pursuant to instructions, I left Washington and proceeded to Greeley, Colo., where I arrived July 30, and where I found Dr. C. A. White in waiting, who reported to me as directed. On the following day, accompanied by Mr. William Cleburne, Dr. White and myself proceeded to Golden, Colo., where we made such general observations of the geology and paleontology of that region as it was possible to do under the circumstances. Returning to Greeley on August 2, we learned by telegram of the probability that Dr. White would be appointed commissioner for the location of artesian wells on the Great Plains, which necessitated an entire change in my plans for the summer's work.

While awaiting developments respecting the above-named appointment, it was decided to accompany Mr. Cleburne to a point on the Platte River, some fifty miles below Greeley, where fossils were reported in a recent railroad cut. Accordingly we left Greeley, and on August 4 visited the point named. No vegetable fossils were exposed, the formation being Cretaceous.

Leaving Mr. Cleburne at this point, Dr. White and
27 myself, with the | assistance of Prof. Lawrence Bruner, proceeded with the same outfit with which we started from Greeley, to a place some fourteen miles north of Fremont Orchard (Girardot's Ranch), known as Girardot's Coal Mine, where the Laramie Group is well exposed, and where abundance of fucoids (*Halymenites*) occur above shell-beds. Having examined this locality and made collections, the party returned to Greeley on the 6th.

Being obliged to wait still further for orders, two outfits were employed, and Dr. White proceeded to Crow Creek, while I, accompanied still by Professor Bruner, visited a bluff near the mouth of Saint Vrain River, a short distance from Platteville, Colorado, where the base of the Laramie Group is exposed, as also the extreme Upper Cretaceous. Nothing of a vegetable character excepting fucoids and some silicified wood was found in this locality. I therefore decided to visit two points in the vicinity of Fort Collins, known as Fossil Creek Spring and Cañon, which were reported to yield fossil plants.

These localities were examined on the 9th and 10th of August. They were found to be Cretaceous strata (Fox Hills Group), containing abundant remains of *Inoceramus*, *Baculites*, &c. From this point I again returned to Greeley on the 11th. Dr. White had also returned from Crow Creek, and had then received definite instructions to proceed to the investigation of artesian wells. Two boxes of fossils were prepared for shipment from Greeley, the result of collections up to that time. It was then decided to proceed to Denver and await further instructions as well as funds. While waiting at Denver, taking Professor Bruner, who offered his services without compensation, I visited Golden and made more careful observations than it had been possible to do on a previous occasion, remaining there during the 15th, 16th, and 17th, and returning on the 18th, having collected and left ready for shipment five boxes of fossil plants chiefly from the slope of South Table Mountain.

Having received the necessary funds to proceed, though unaccompanied by further instructions, and Dr. White having left my party permanently, I was compelled to adopt such a plan for the remainder of my field season as upon the whole seemed best. I arranged with Prof. Lawrence Bruner, who was employed as assistant entomologist of the Department of Agriculture, to accompany me in the interest of the Department of Agriculture, since the field which he desired to examine corresponded with that in which I alone could operate, namely, the various points of interest in the nearer vicinity of the Union Pacific Railroad.

I therefore proceeded to visit in succession the principal localities along that road at which collections of fossil plants had been made. The first of these was reported to be Rock Station, Wyoming, where we arrived on the 26th. A few species had been reported from this locality, but on examination I was soon satisfied that none had been found in the vicinity of the station—the horizon being evidently Upper | Cretaceous, or Fox Hills Group, and containing
28
Inoceramus, *Ammonites*, and other characteristic Cretaceous fossils. Little better success was had at Medicine Bow, where Cretaceous strata still prevailed, as revealed at one spot by the presence of *Baculites*, *Scaphytes*, &c.

The next locality visited was at Carbon Station. Here, for the first time, vegetable remains were found. The plant-beds lie immediately over the coal-beds, and fossils may be easily obtained. We remained at Carbon until August 29, and prepared for shipment five boxes of fossil plants.

From Carbon I proceeded, still accompanied by Professor Bruner, to Black Butte Station, now reduced to a side track, where three days were spent, and four boxes of fossils obtained, containing many very excellent specimens, the locality being one of unusual interest.

On September 1 I reached Point of Rocks, and remained there until the 3d, making collections. While there I received valuable assistance from Mr. Levy, station agent at Point of Rocks Station. The geology and paleontology of this region especially merit the closest attention. A species of *Salisburia*, which may be the same as that found near Fort Ellis (*S. polymorpha*), occurs at one point in considerable abundance. Many of the specimens obtained at Point of Rocks when shown to Dr. J. S. Newberry, a short time since, were regarded by him as new to American paleontology. Two boxes of specimens were shipped from Point of Rocks.

Green River City was the next point visited, but as little could be done without securing an outfit and proceeding some distance from the railroad, and as time was limited, I remained here only two days, with small success.

Accounts which I had received from Mr. Wm. Cleburne, chief engineer of the Union Pacific Railroad, and from Mr. J. Budd, superintendent of construction, relative to rich fossil deposits discovered along the line of the Oregon branch, now in process of construction from Granger, Wy., up Hams Fork and through Hodge's Pass, induced me to abandon further operations in the vicinity of Green River and to endeavor to reach the localities designated by these gentlemen. Accordingly on the 7th instant I proceeded to Granger, and on the following day took the construction train of the Oregon branch to the terminus, some 26 miles

distant. Here an outfit was obtained from the ranch of Mr. Charles F. Roberson, and I proceeded to the tunnel now being cut through a ridge forming the divide between the Green and Bear River drainages. The coal formation was reached before leaving Hams Fork to enter the Pass, and continues some five miles west of the divide, the strata dipping to the west and representing an immense thickness of coal deposits. Fossil plants were found at nearly all horizons above the coal beds, and at two places they were exceedingly abundant, yielding specimens of superior perfection and interest. Large collections were made. On the 11th a point seven miles west of the tunnel was visited, known as Bell's Fish Cliff. Here the Green River
formation again appears, and the cliff resembles in 29
most respects those in the vicinity of Green River City; but Messrs. John and Jesse Bell, who have collected fossils here by blasting, have discovered very large palm and other leaves and vegetable remains. Owing to lack of facilities for detaching rocks I was unable to obtain any very perfect specimens, but succeeded in finding fragments of gigantic palm leaves, and a few specimens of other forms of vegetation. Returning on the 13th to Mr. Roberson's ranch I retained the same outfit, and on the 14th and 15th visited two remarkable localities known as "Petrified Forests." The first one examined lies some four miles west of Hams Fork, at a point about twenty-five miles above Granger. It is a very interesting spot and demands a more detailed description than can be given here. The other lies about six miles east of Hams Fork, opposite a point about thirteen miles above Granger. This forest is much more extensive than the former and presents some remarkable features. Both deserve a more careful study than I was able to give them, but the material which I have brought from them may add something to what is already known respecting the nature of these petrifactions.

Reaching Granger on the 16th, I found that a limit to my season's operations had been reached, and accordingly, after preparing for shipment the fourteen boxes of specimens obtained on the last expedition, I proceeded to Ogden for the purpose of preparing my report and making other necessary preparations for returning to Washington.

During the entire expedition I was accompanied, as above stated, by Prof. Lawrence Bruner, who is an accomplished collector and a keen observer of geological and paleontological facts, as well as those of his own specialty—entomology—and to him I am indebted for much valuable assistance.

Returning, I reached Washington on October 1, and reported in person.

From October 1, 1881, until January 1, 1882, I was employed in the office of the Survey, performing literary work connected with the publications of the office, and editing and publishing Bulletin No. 22 of the United States National Museum, previously prepared by myself. On the first of the present year the fossil plants already in the National Museum, which had been catalogued by Professor Lesquereux, and by him sent to the Museum in the boxes, were turned over to me for classification, and from that time until June 18 I was engaged upon this work. From June 19 to the end of the fiscal year I was engaged chiefly in unpacking the 31 boxes of fossil plants collected by me during the previous field season and in the study of those fossils, preparatory to their ultimate determination.

I am, very respectfully,

LESTER F. WARD.

Hon. J. W. POWELL,

Director U. S. Geological Survey, Washington, D. C.

185. [Twofold Drainage of the Dismal Swamp Conditions to the Preservation of Leaves in a Fossil State]

History.—Remarks on the paper of Prof. W. C. Kerr on "The Geology of Hatteras and the Neighboring Coast," read April 7, 1883.

Bulletin of the Philosophical Society of Washington, Washington, D. C., Vol. VI, 1884, p. 30.

MR. WARD remarked that, in traversing the Jericho canal of the Dismal Swamp in a row boat, he had observed an outward flow at both ends of the canal, showing that, by continuous water passage, a divide was crossed between Lake Drummond and the James river.

He criticised the doctrine taught in text-books and popular writings that the preservation of leaves in a fossil state is due ordinarily to river action and delta formation. More favorable conditions are to be found in swamps.

186. Fontaine's Older Mesozoic Flora of Virginia[1]

History.—Written Oct. 31–Nov. 28, 1884. I sent it to *Science*, but it was returned Dec. 20th with request to cut it down, which I did, and sent it again Jan. 12, 1885. Though written as a review, it was made an article with the above title, the reference to the work being made a footnote.

Science, Cambridge, Massachusetts, Vol. V, No. 113, April 3, 1885, pp. 280–281.

THIS work is one of the smallest of this series; but it is one of merit and importance. Although the number of fossil plants from Virginia strata here enumerated is not great, they are so thoroughly illustrated, and so critically discussed, that their diagnostic value is fully brought out. Professor Fontaine may fairly claim to have demonstrated, from evidence furnished by the plants alone, that these older mesozoic beds, which had not previously been clearly distin-

[1] Contributions to the Knowledge of the Older Mesozoic Flora of Virginia. By William Morris Fontaine. Washington, Government, 1883, xii+144 pages, 54 plates. Monographs of the U. S. Geological Survey, VI.

guished from the younger ones, and had been commonly grouped with the latter as the trias of Virginia, can scarcely extend so low as the extreme upper trias, and conform more closely to the rhaetic of Franconia, Bayreuth, and Palsjö, or even to the lias of Rajmahal.

This conclusion, of course, is derived from an analysis of the species discovered, and a study of their affinities with species obtained from strata in other parts of the world, whose geological position is fixed with some degree of accuracy. This subject is discussed at length. The substance of it can be given in a few words.

The whole number of distinct plants described is forty-five. Eight of these were already known from other localities under established names; four more of this class are referred to different genera or species: making twelve not confined to Virginia. Of the remaining thirty-three which are so confined, nine have close affinities with species already described. It thus appears that considerably over half of the entire number are peculiar to the locality, and have no weight in determining its horizon. The decision must therefore turn entirely upon the twenty-one species which are either themselves found outside of Virginia, or are nearly allied to such as are so found.

The author has made some errors in his table of distribution, such as the omission of Schizoneura planicostata, which he describes in the text, and the failure to assign Ctenophyllum Braunianum to its proper horizon (rhaetic). These corrections made, we find that while only one of the species (Asterocarpus platyrachis) has its nearest affinity with an exclusively triassic plant, and only seven have their nearest affinities with exclusively Jurassic plants, there are ten which have either been found in the rhaetic only, or are most closely allied to such as have only been so found. Thus thirteen species, or about five-eighths, may be classed as rhaetic plants; and only four, or less than one-fifth, can at best be set down as triassic. The seven Jurassic species are mostly from the lias, or lower oölite, which, while not negativing the rhaetic character of the Virginia beds, does seem, when coupled with the rest of the evidence, to negative their triassic character.

We have not space to go further into details, and will merely add, that, while our analysis of his facts differs slightly from that made by Professor Fontaine, the conclusion which flows from it is the same; viz., that in so far as fossil plants can be depended upon to correlate the deposits of different parts of the world, those of the Richmond coal-fields point to the rhaetic of Europe as the age to which they must be referred.

It is something to have even thus far fixed the geological position of this hitherto unsettled formation; but those who are specially interested in the progress which is taking
281 place | in vegetable paleontology will perhaps regard as still more important the discovery and careful characterization of the twenty-eight forms which the author describes as wholly new to science, twenty-six of which receive the rank of species, and for the satisfactory classification of which he has found himself obliged to create the two new extinct genera, Mertensides and Pseudodanaeopsis. Of these twenty-six new species, eight are allied more or less closely to known forms, leaving eighteen species so distinct that the author has been unable to compare them with anything that has been hitherto described. This is remarkable, in view of the great uniformity which is generally found to exist in the floras of the earlier geological formations at points the most widely separated geographically. It seems to indicate an unexpected divergence of the mesozoic flora of North America from that of Europe and other districts of the eastern hemisphere.

An important feature of the work, not indicated by its title, is a careful revision by Professor Fontaine of the researches in the same line of Dr. Ebenezer Emmons in North Carolina, made some thirty years ago, and published in part vi. of his "American geology," 1857. The fossil plants found by Dr. Emmons, and figured in this work, are described under the head of "Fossils of the trias;" but Professor Fontaine thinks he has conclusively shown, from a study of his figures and descriptions (the fossils themselves having been destroyed during the war), that this "trias" of Emmons in North Carolina is identical with his "older mesozoic" of Virginia.

The work is copiously illustrated, there being, in all, fifty-four plates, the last six or seven of which are devoted to the reproduction of the figures of Emmons. The photo-engraving process is employed, and we have here a standard from which to judge of its applicability to the illustration of fossil plants. In some respects it proves quite satisfactory; at least, when we consider its cheapness, and the advantage it thus furnishes of allowing, at moderate cost, the ample illustration of species, which is so great a necessity in this branch of paleontology. But we do not think the most has been made of the process in the present work.

The index, which is otherwise good, contains one feature which cannot be too highly commended to authors of such works. This is the reference to plate and figure, as well as to page; which, in more than half the cases, saves the reader the labor of looking twice.

187. Lesquereux's Cretaceous and Tertiary Flora[1]

History.—I had read the proof of this work and retained a set of the page proofs from which I prepared a review early in 1884, and held awaiting its appearance, which was not until February, 1885. I had the misfortune to lose my manuscript one rainy day (Feb. 9, 1885), when I had taken it to the Government Printing Office to look after the state of the volume. It fell out of a bundle of papers in the street. I missed it before I reached home and returned along my exact route, but some one must have picked it up. I wrote the review entirely anew Feb. 14–19, 1885.

Ibid., No. 116, April 24, 1885, pp. 348–349.

THIS work is the third, and will undoubtedly be the last, of the series of final reports contributed by this author to the publications of the U. S. geological survey of the territories in charge of

[1] Contributions to the Fossil Flora of the Western Territories. Part III. The Cretaceous and Tertiary Floras. By Leo Lesquereux. Report of the U. S. Geological Survey of the Territories. F. V. Hayden, U. S. Geologist in charge. Vol. VIII, Washington, Government, 1884, xii + 283 pages, 59 plates, 4°.

Dr. Hayden, and which together constitute a truly great and enduring monument to the fame of the now venerable paleobotanist. The first of these volumes appeared in 1874, and was devoted to the flora of the Dakota group, the only cretaceous flora then known in the west. The second, a larger work, came out in 1878, and was called the "Tertiary flora;" but more than half of it was taken up with species of the Laramie group, by many regarded as cretaceous. The present volume is in the nature of a review of the whole field covered by the two preceding, bringing the matter down to date, and embraces some Pacific-slope miocene localities in addition.

The first hundred and twenty pages and eighteen plates are devoted to a revision of the flora of the Dakota group, and the description and illustration of thirty-five new species from that formation. At the close of this division of the work, the author introduces an exhaustive table of distribution, extending it to embrace the entire Cenomanian formation, to which he assigns the Dakota group, as well as the middle cretaceous of Greenland. He divides the Cenomanian of Europe into three groups of localities: viz., 1, Moletein, Quedlinburg; 2, Quadersandstone, Harz, Bohemia; | 3, Niederschoena, Saxony, Hungary. Some of
these districts are exceedingly vague; Quadersand- 349
stone, for example. Niederschoena is in Saxony; and Quedlinburg is in the Harz district, at the same horizon as Blankenburg, which is not Cenomanian at all, but Senonian. From all these sources he enumerates 442 species,—a number which is still too small. The Dakota group alone furnishes 195 species.

The second division of the work relates to the Laramie group, but does not review its flora. Some dozen additions to it, made by Mr. Lakes at Golden, Col., are described, six of which are new species. Mr. Lesquereux here discusses again the geological position of this group, and, while still insisting upon its eocene character, admits that its flora resembles that of the travertines of Sézanne in the Paris basin, but which are known to lie considerably lower than the coarse limestone and lignites that prevail in that district. In his table of distribution he only enumerates 207 species; but the reason for this paucity is his failure to recognize as Laramie the plants described from the Fort-Union group,—the upper Missouri and lower Yellowstone region, and the Bad lands of Dakota.

The third division of the work consists of an exhaustive survey of the flora of the Green-River group; and, as this had not previously been done, it forms altogether the most valuable part of the treatise. Since the appearance of the "Tertiary flora," a large amount of material from this formation had accumulated in the author's hands, out of which he obtained no less than ninety new species. The most fertile source of this material was the small locality in South Park, Col., known as Florissant, from which, in a light volcanic ash, also containing insect-remains, an immense number of beautifully preserved specimens of fossil plants have been derived. The other principal localities grouped under the general designation of "Green-River group," are those of Green-River Station and Alkali-Stage Station, Wyoming; Elko Station, Nev.; and a place reported as in "Randolph county." As to this last, as there appears to be no Randolph county in any western territory, it is probable that Randolph courthouse, Rich county, Utah, is meant, which is the same as is otherwise known as Bell's Fish-Cliff, where fine specimens of palm-leaves and other fossil plants are found. The locality called Barrel's Springs is also here referred to the Green-River group, although it appears in the preceding table as belonging to the Laramie group. This is confusing, to say the least.

We have not space to show how the floras of these several localities are correlated by the author; but the occurrence of identical and wholly characteristic species in several of them seems to establish their geological synchrony with considerable certainty. This formation is now commonly regarded as eocene; but Mr. Lesquereux, led, as in the case of the Laramie, by the affinities of the flora with that of Europe, insists upon placing it somewhat higher, and calls it "oligocene."

The remainder of the work is devoted to what is called the "miocene flora." So far as the localities on the Pacific slope (Chalk Bluffs and Corral Hollow, Cal.; John Day valley, Ore.; and Alaska) are concerned, this reference is doubtless correct; but the large collections from the "Bad lands of Dakota" belong almost without question to the Fort-Union group, and should have been referred to the Laramie, with which the invertebrate fauna forces us to correlate that group. It is true that this flora has a marked miocene aspect when compared with those of European strata, and that several species seem to have persisted from that period to the present (*e. g.*, Corylus Americana, Onoclea sensibilis); but the entire Laramie flora is also strongly miocene, and at least one species (Ginkgo biloba, L.) of the living flora has come down to us seemingly unchanged from the typical Laramie of Point of Rocks, Wyoming.

Geological considerations aside, this volume is one of the most important that have lately appeared upon the paleontology of western America, and, should it prove his last work, would fittingly crown the long and faithful labors of its justly celebrated author.

188. Report on the Fossil Plants of the U. S. National Museum for 1883

History.—Written Jan. 14–15, 1884.

Annual Report of the Board of Regents of the Smithsonian Institution for the year 1883, Washington, 1885, p. 263. Reprint of the Report of the Assistant Director of the U. S. National Museum, p. 103.

THE most important addition which was made to the department during the year was a large collection of fossil plants from the Green-River group of Elco Station, Nev., Bell's Fish Cliff, Alkali-Stage Station, Wyoming, and Florissant, Colorado, but chiefly from the last named locality, consisting of more than 700 specimens belonging to nearly 100 species. These have been numbered and catalogued and form part of the reserve series.

The only other addition of numerical importance consists of 236 specimens from various localities in Europe and America, which were found in the north tower of the Smithsonian building, and which have also been duly installed.

The present state of the collection is as follows:

Number of specimens	4,924
Number of species	871
Of which there are—	
Paleozoic	236
Cretaceous	142
Tertiary	493

At the close of the year, in order to make room for a large collection of fresh material for study, it was found necessary to remove some of the duplicates. These were taken entirely from the Paleozoic and Mesozoic series, 896 specimens from the former and 195 from the latter, making 1,091 specimens. They were all carefully selected from the least perfect of the most abundantly represented species and have been placed in drawers, properly labeled, and are ready to be sent to the Armory building for storage.

189. Bibliography for 1883

History.—Written Feb. 8, 1884.

Ibid., pp. 310–312 [150–152].

WARD, LESTER F.—Captain C. E. Dutton on the Hawaiians.

(Science, February 9, 1883, 1, pp. 9–10.)

Report of an oral communication made by Captain Dutton before the Anthropological Society of Washington, January 2, 1883, on the above subject, from notes taken down and written out.

—— Plant life, past and present.

(Science, May 4, 1883, 1, pp. 358–359.)

Abstract of a lecture delivered at the National Museum February 24, 1883. Gives the system of botanical classification proposed in the lecture, and a table showing the number of species of fossil plants belonging to each of the principal groups for the several geological horizons, as also the number of living plants of each group known or estimated.

—— Dynamic sociology, or applied social science, as based upon statical sociology and the less complex sciences.

Two volumes, 12mo. Vol. I, xx+706 pp., vol. II, vii+690 pp. New York, D. Appleton & Co., 1883 (published June 2).

The principal aim of this work is to point out the superiority of the method of intelligent design over that of spontaneous self-adjustment in the attainment of the objects of desire and of social advancement. It is a plea for the legitimacy of intelligent action on the part of society in securing
311 its own interests and advantage as against the
[151] philosophy of inaction which, in recog|nizing the great secular effects of non-intellectualized activities, neglects the factor of mind which entered into the problem at a certain point, and which tends to discourage the exercise of the legitimate power that mind is capable of exerting for the general good. The work is an argument against the *laissez faire* doctrine and in support of a general policy of regulation applied to social operations according to the same principles as those on which physical phenomena are regulated by the inventive genius of man.

—— Marsh and aquatic plants of the Northern United States, many of which are suitable for carp ponds.

(Bulletin U. S. Fish Com., III, Sept. 6, 1883, pp. 257–265.)

The geographical range of the species is given, and those specially designated that are found in the District of Columbia and vicinity of Washington.

—— On the position of the Gamopetalæ.

(Proceedings of the American Association for the Advancement of Science, Montreal, 1882 [Salem, 1883], vol. XXXI, pp. 460–462).

Abstract of a paper read before the biological section, designed to show that the Gamopetalæ are the most highly developed type of Dicotyledons, were latest developed, and should occupy the highest place in the systematic arrangement.

—— The organic compounds in their relations to life.

(Proceedings of the American Association for the Advancement of Science, Montreal, 1882 [Salem, 1883], vol. XXXI, pp. 493–494.)

Abstract. This paper was published in full in the American Naturalist, Dec. 1882, XVI, pp. 968–979, and its title appears in the report of the assistant director of the National Museum for 1882, pp. 67–68.

—— Classification of organisms.

(Proceedings of the American Association for the Advancement of Science, Montreal, 1882 [Salem, 1883], vol. XXXI, pp. 493–494.)

Abstract of a paper read before the biological section. Organisms are classified according to their ability to appropriate nutriment from inorganic or only from other organic bodies. The paper was read from proof sheets of chapter iv of "Dynamic Sociology," (vol. I, pp. 347–355), then passing through the press.

—— Report to the Director of the United States Geological Survey on the operations of the division of paleobotany during the fiscal year 1882–'83.

(Fourth Annual Report of the U. S. Geological Survey (Report of the Secretary of the Interior, vol. III), pp. 50–51. Washington, Government Printing Office, 1883.)

—— Scientific notes communicated to Science:

1. On the preliminary study of a collection of fossil plants from the Lower Yellowstone.

   (Science, June 15, 1883, I, p. 559.)

2. On Gray and Trumbull's review of De Candolle's "Origine des plantes cultivées."

   (Science, June 29, 1883, I, p. 616.)

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3. On a collection of fossil plants from the Fort Union group made by the writer during the months of July and August, 1883, in the Yellowstone and Missouri Valleys.

   (Science, October 12, 1883, II, p. 517.)

4. On the descent of the Missouri River from Fort Benton, Mont., to Bismarck, Dak., in an open boat by a geological party of which the writer was a member, made in August and September, 1883.

   (Science, October 12, 1883, II, pp. 517–518.)

—— Remarks before the Anthropological Society at its fifty-eighth meeting, held November 7, 1882, upon the address of Dr. J. C. Welling, vice-president of the Section of Sociology, on the "Turning-point of modern sociological science."

(Transactions of the Anthropological Society of Washington, II, pp. 31–33, Washington, 1883.)

Criticism of the views of Messrs. Herbert Spencer, W. R. Greg, and others who oppose all humanitarian enterprises, on the ground that they are contrary to the law of the survival of the fittest, and that they tend to produce social degeneracy. It was held that all distinctively human activity is opposed to the natural method of development, and is far more effective.

—— The department of fossil plants in the U. S. National Museum, 1882.

(Report of Assistant Director U. S. Nat. Mus. for 1882 (1883). Smithsonian Report for 1882 (1884) pp. 150–151, 183–186.)

190. Premature Appearance of the Periodical Cicada

History.—Written June 2–5, 1885. The observation was laid before the Biological Society of Washington on Dec. 13, 1884, from notes made at the time. Professor Riley's paper replying to it was read on May 30, 1885. In *Science* of July 3, 1885, pages 3–4, occurs a note by him on the subject, which seems to be an abstract of his remarks before the Society. But why so long delayed? It is full of sophistry, such, for example, as the implication that my testimony was weakened by the fact that I could not be sure whether it was in 1854 or 1855 that I first became familiar with the note of the cicada! Besides verifying the note very carefully in 1885, although, as he says, it was an abnormal year, I have been able to do so much more fully once since, viz., in 1902.

Science, Cambridge, Massachusetts, Vol. V, No. 123, June 12, 1885, p. 476.

ON the morning of Oct. 12, 1884, when I chanced to be in Virginia, near Clifton station on the Midland railroad, my attention was attracted by hearing at some distance the characteristic, and to me perfectly familiar, note of the periodical cicada (C. septendecim). Regarding this as a somewhat novel occurrence at that time, I decided to investigate it, and at once proceeded in the direction from which the sound emanated. Though the notes were, as usual, interrupted by short intervals, I found it easy to correct my direction with each recurrence of the sound, and was soon at the foot of some small oaks in which the insects were located. There were at least three males, and the interval between the notes was quite short. I stationed myself under one of the trees, and carefully located the spot from which the sound of one of the insects proceeded. Although it was not possible, from any position I could assume, to see the insect itself, hidden as it was in the dense foliage, and at the height of some twenty feet, yet I soon knew within a few square feet the precise part of the tree occupied by it. I remained some fifteen minutes listening to the peculiar murr-r-r-r-row with which I had been deeply impressed when a boy (1854 or 1855) in my native state (Illinois) at the time of the great swarm that left its withering blight on all the vegetation, but which I have since heard for days together as late as 1878. I think all who are really familiar with this sound will agree with me that it has no counterpart in the whole range of sound-producing creatures. The body of the note lasts, on an average, about two seconds, upon a uniform key, when, without being interrupted, the pitch rapidly drops, with what musicians call a 'slur,' for, as near as I can judge, a full octave or more, and the note abruptly terminates. This peculiar termination is difficult to detect where the trees are full of the singing insects, but it is always present; and in this case it was clearly marked, affording me a fine opportunity for studying the phases of the note, and timing its length. Had I been an entomologist, and aware how anomalous this occurrence was, I should doubtless have persisted until I had secured a specimen, and should have searched for exuviae, etc.; but as I felt absolutely certain as to what I heard, and did not know but that it might be a somewhat ordinary occurrence, I merely made a note of the facts, and leisurely left the spot.

Several days afterwards, happening to be in conversation with Prof. C. V. Riley, I casually mentioned the circumstance as a fact in his line, fully expecting him to reply that it was no very unusual thing. To my great surprise, he pronounced it impossible, and wholly discredited the accuracy of my observation. He said I must have heard some other species of cicada; and, when I asked him what other species had a note precisely like that of the periodical one, he could do no better than to name the common harvest-fly (Cicada pruinosa), the sharp, shrill note of which was also perfectly familiar to me, and so different that I could no more confound it with the other than I could the chirp of a sparrow with the cooing of a dove. My attempts to convince him by describing the sound were as ineffective as though I had been speaking to one who was himself unfamiliar with it.

Having the courage of my convictions, I made bold, on the first opportunity, to lay the subject before a Washington scientific body in the form of a verbal statement of the case, whereupon the learned professor surprised me, not only by no longer positively gainsaying it, but by propounding a theory according to which he admitted the possibility of my observation having been correct. His theory was, that, owing to the exceptional heat of the latter part of that season, a few of the brood of 1885 which were nearest the surface might have been prematurely brought out the autumn before. This seemed very reasonable to me, and I promptly (and seriously) congratulated Professor Riley on having discovered a theory to explain my fact.

Here I supposed the matter was to rest; and here it did rest until a few days ago, when to my further surprise, at the close of an exceedingly interesting paper which Professor Riley read before the same society, on the brood of cicadas which has just appeared, he took occasion to bring up the subject of my Virginia observation, and to pronounce it utterly worthless, and the occurrence impossible as contrary to all the canons of entomology. On being reminded of his own theory, above stated, which he seemed to have forgotten, he could not disclaim it, and virtually renewed it, leaving himself in the position of both denying and admitting the possibility of the event.

I do not make these statements with a view to arousing a controversy, but solely in the hope that some of your many observant readers may be able to confirm and perfect the confessedly incomplete record which I hereby make of this singular incident.

I will, however, venture a suggestion drawn from a field with which I am better acquainted. The theory of Professor Riley might, I think, be greatly strengthened by facts derived from plants. The effect of a protracted warm spell in autumn upon the vegetation of this climate has been the subject of investigation on my part for a series of years; and the autumnal flowering of strictly vernal species is a fact attested by a score or more of species, most of which have been recorded and published. It is not contrary to the canons of botany, but consonant to a rational understanding of causes and effects. And why should not similar causes produce similar effects on insects? For one, I cannot doubt that they do so; and I am as firmly convinced now, as I was at the time, that the sound I heard proceeded from veritable seventeen-year locusts that were thus prematurely brought from their long subterranean dungeons into the genial sunlight of that warm October day.

191. The Ginkgo-Tree

History.—Written May 6–18, 1885. All botanists of that date classed Ginkgo among the *Coniferæ* (*Pinales*). This article is virtually a protest against this, and it was only a few years after this, I will not say at all on account of it, that Engler erected it into a distinct class (*Ginkgoales*) and family (*Ginkgoaceæ*), in which he included the extinct genera *Baiera*, *Czekanowskia*, and *Rhipidopsis*. Fossil forms of the genus *Ginkgo*, belonging to several species, were found by me in great beauty and abundance in the Jurassic of Oregon in 1899, which have been thoroughly worked up and published.[1]

Ibid., No. 124, June 19, 1885, pp. 495–497.

AN event of considerable interest to botanists has just occurred at Washington in the flowering, for the first time, of two of the ginkgo-trees in the U. S botanic garden.

In passing the grounds on Saturday evening, May 6,

[1] Twentieth Annual Report U. S. Geological Survey, Pt. II, 1900, pp. 373, 375, 376; Monographs of the U. S. Geological Survey, Vol. XLVIII, Text, pp. 120–128; Plates xxx–xxxiv.

after the gates were closed, my attention was attracted to a tree standing just inside the enclosure, which, though as yet nearly leafless, was loaded with staminate aments borne in terminal clusters on very short branchlets all along the branches, even down to the base of the larger ramifications. A glance showed that it was a ginkgo, though I had never seen one in flower before; and, after examining it sufficiently, I went away, and was obliged to wait until Monday morning before I could notify the superintendent, Mr. W. R. Smith, and institute a search for other trees in the same condition.

Presuming that, as is usually the case in public gardens and parks, all the trees in the city would also be males, so that no opportunity would exist for witnessing the fruiting of this tree, I was most agreeably disappointed when I learned that Mr. A. L. Schott had found another tree in flower in the same enclosure, and that this tree was a female. I thereupon carefully inspected both these trees, and found that anthesis was so nearly synchronous in the two sexes that I was able on the 5th to pronounce them ready for fertilization. But as they stand some seventy-five yards apart, with the superintendent's house and other obstacles between them, it was evident that this could not take place unaided; and accordingly, with the hearty co-operation of Mr. Smith, the work of artificial pollinization was undertaken. This has been repeated several times at different hours of the day, and so thoroughly performed that it is hoped the result will be successful,[1] and that fruit will be borne this season.

The so-called Japanese ginkgo,[2] or maiden-hair tree

[1] Evidence is abundant (June 15) that artificial pollinization was successful.

[2] The orthography of this word is not settled. Linné (Mantissa plantarum, Holmiae, p. 313) wrote *ginkgo*, as did also, apparently, Kaempfer before him (Amoenitat. exotic., 1712), and as all botanists since have done, and do still; but nearly all lexicographers reverse the consonants, and write *gingko*, usually without explanation. Littré

(Ginkgo biloba, Linn.; Salisburia adiantifolia, Smith), is one of the most interesting trees that have been introduced into the landscape plantations of Europe and America. Although possessing deciduous foliage and broad green leaves, it nevertheless belongs to the Coniferae, though its affinities with the rest of that family are anomalous, being closest with the yew tribe. An examination of its leaves shows them to be wholly unlike those of any other phenogamous plant. They are deltoid in outline, and the fine nerves that run from the narrow base to the broad apex fork several times in their course, after the manner of ferns. In fact, a ginkgo leaf very closely resembles a much enlarged and thickened pinnule of the maiden-hair fern (Adiantum), —a resemblance which not only suggested to Smith the specific name adiantifolia, but has caused the tree to be popularly called in some localities the maiden-hair tree.

A study of the paleontological history of this remarkable plant reveals the fact that it is an archaic form, and the sole survivor of an otherwise extinct type of vegetation which had numerous representatives in the remote geologic past. The Salisburia adiantoides of Unger, found in the upper miocene of Senegal, is not essentially different from the living species; and Professor Heer detected it again in the miocene strata of Greenland. In 1881 I was so fortunate as to obtain from Laramie strata at Point of Rocks Station, Wyoming Territory, a form which, except for its smaller leaves, appears to be identical with the living one; and in 1883 I found in Fort Union strata, on the lower Yellowstone, a slightly different form, with larger leaves, showing no lobes, proving that the present living form has come down to us, almost unchanged, from a period as remote at least as the cretaceous age. But other, and distinct forms are found in the cretaceous, and still others, showing greater and greater divergence, as far back as the

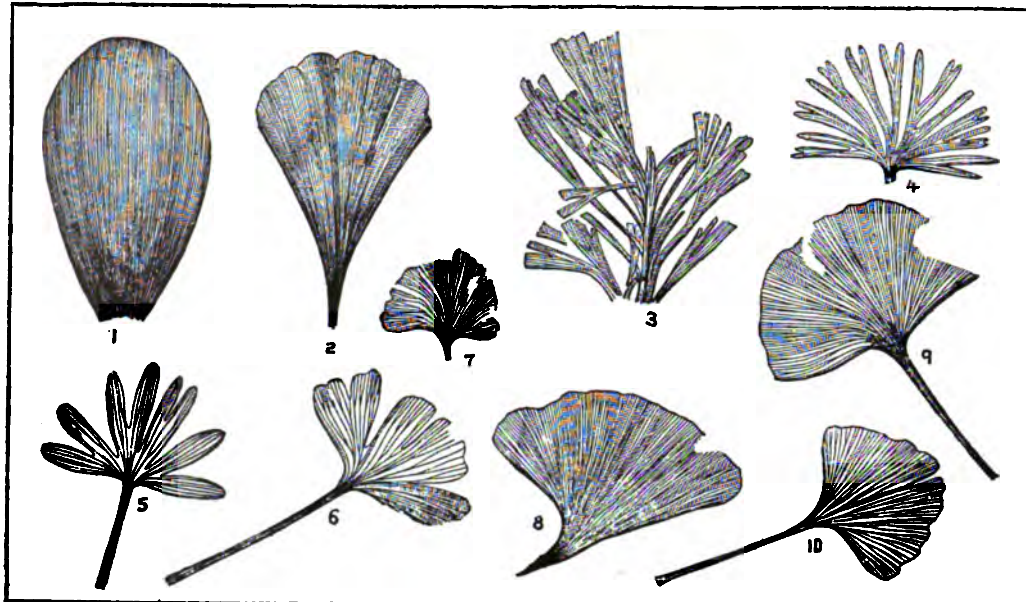
alone, of all I have consulted, gives both spellings. In the supplement to Webster's dictionary the word is said to signify silver-fruit, and it would seem that the etymology ought to determine the orthography.

Jurassic; those of the Oölite bearing clear evidences of having been derived from a series of still older, digitate-leaved forms (Jeanpaulia, Baiera, etc.) whose relationship with the ginkgo was not suspected until these intermediate ones had been brought to light by Heer from the mesozoic rocks of Spitzbergen and Siberia. In fact, until recently these earlier Jurassic forms, which had been long well known, were from their nervation referred to the family of ferns; as, indeed, a fossil leaf of the ginkgo would probably be now, if the living plant were unknown.

But even this is not all. By another series of far more ancient forms (Trichopitys, Psygmophyllum, Noeggerathia), this persistent type may be traced still farther back, even across the boundary between mesozoic and paleozoic time, until, in the great carboniferous flora, it has been connected,
496 almost without | question, with the abundant and so long enigmatic Cordaites. This ancient plant was formerly regarded as the forerunner of the family of cycads; but now, in the light of these discoveries, it is almost universally regarded as coniferous. It was one of the earliest types of land vegetation to appear on the globe, running far back into Devonian, and even into Silurian time.

The figures of the accompanying plate, kindly drawn for me by Ensign Everett Hayden, U. S. navy, have been selected with a view to illustrating the phylogeny of the genus Ginkgo: and they are numbered, and as nearly as practicable arranged upon the plate, in the order of supposed development, from the true Cordaites to the living Ginkgo biloba; this being also, as will be observed, substantially the chronological order of their appearance.

The broad leaves of some species of Cordaites, though more or less elongated or elliptical in shape, possess a nervation strikingly similar to that of the later ginkgo-like forms; while the familiar fruits so abundant in the coal-measures, and which are now known to be those of Cordaites, resemble in an equally remarkable manner the almond-shaped nuts borne by the present maiden-hair tree.



PHYLOGENY OF THE GENUS GINKGO.

1. Cordaites lingulatus, Grand'Eury: carboniferous, Central France. 2. Psygmophyllum (Noeggerathia) flabellatum (Lind. & Hutt.), Schimp.: carboniferous, England. 3. Ginkgophyllum Grasseti, Saporta: Permian, Hérault. 4. Baiera (Jeanpaulia) Münsteriana (Presl), Heer: rhaetic, Bayreuth. 5. Ginkgo Sibirica, Heer: oolite, Siberia (restored by Heer). 6. Ginkgo digitata (Brongn.), Heer: oolite, Cape Boheman, Spitzbergen. 7. Ginkgo Laramiensis, n. sp.: Laramie, Point of Rocks, Wyoming Territory. 8. Ginkgo (Salisburia) adiantoides, Unger: Fort Union beds, lower Yellowstone. 9. Ginkgo (Salisburia) adiantoides, Unger: miocene, Greenland. 10. Ginkgo biloba, L.: living, Washington, D. C. All the figures are reduced one half.

Though these carboniferous plants were at first commonly regarded as cycadaceous, still the long, ribbon-like leaves of certain cordaitean forms (Poa-Cordaites of Grand'Eury) led some eminent authors, including the late Professor Göppert, to consider them monocotyledonous, and the precursors of our lilies, reeds, grasses, and also of the palms. But even these mistakes have not been without their uses. It is the peculiarity of science that in its very errors knowledge is extended. The theory that Cordaites was cycadaceous was not wholly false; the suggestion that it might be monocotyledonous contained a "soul of truth"; and the present opinion that it was coniferous is, I venture to assert, not wholly true. The truth lies in the midst of all these opinions. It seems to be this: there were no true paleozoic Cycadaceae, monocotyledons, nor Coniferae; but Cordaites was the prototype of them all. It was in the Trias, whose flora is unfortunately the least known of all the formations in past time, that all these definite types of vegetation were differentiated from this comprehensive type,—the Cycadaceae through their Macropterygiums | and
Pterophyllums; the monocotyledons through their 497
Aethophyllums and Yuccites; and the Coniferae through their Albertias, Walchias, and Voltzias; while the less modified ancestral type, which began even in the Permian to assume a distinct Salisburian aspect in the genus Ginkgophyllum, has come down to us, as already described, through the several successive modifications which culminated early in the tertiary in the modern form. This general form was somewhat varied, widely distributed, and quite abundant in miocene time; but it is now reduced to a single species, which was probably restricted to the warmer or more eastern districts of the Chinese empire before it was transferred by human agency, and acclimated in Japan, to which country it is now popularly credited. But it is said that there is now no part of the world in which it is found in a strictly wild state, being confined, even in China, to the near vicinity of temples and human habitations.

This interesting tree has for many years been cultivated on the continent of Europe, where it thrives as far north as Copenhagen, but only fruits freely in the more southern districts, notably in the botanic garden at Montpellier, France, where it has been exhaustively studied by Professor Charles Martins and the Marquis Saporta. In the United States there are now many fine trees; but they rarely flower, and, when they do so, the sexes are seldom together, so that fruit cannot be produced. The only exception to this known to me, or to any of whom I have inquired, is the case of a pair of these trees in the grounds adjacent to the University of Kentucky at Frankfort, which are in such close proximity to each other that fertilization regularly takes place, and fruit is borne.

It is owing to these circumstances that such special interest attaches to the coincident flowering this season, for the first time, of the pair of maiden-hair trees in the botanic garden at Washington; and the rare opportunity, should it be afforded, of witnessing all the steps in the reproductive process of this historic type of vegetable life, will be appreciated by both botanists and vegetable paleontologists.

192. Historical View of the Fossil Flora of the Globe—Abstract

History.—Written Aug. 27, 1884. Read Sept. 8, 1884. See Nos. 142, 180, 183, supra, pp. 129, 378, 388; also Nos. 195 and 208.

Proceedings of the American Association for the Advancement of Sc'ence, Philadelphia Meeting, September, 1884, Vol. XXXIII, Salem Press, July, 1885, pp. 493–495.

THE writers of antiquity make no mention of any form of vegetable petrifaction. The earliest allusion to the subject was made by Albertus Magnus in the thirteenth century. Agricola and Gesner treated of petrified wood in the sixteenth century. The first mention of any kind of vegetable impression in the rocks was | made by Daniel Major of Jena, in 1664. In 1699
Edward Lhwyd of London wrote an extensive treatise 494
on such impressions. He maintained that they were the remains of plants that had perished in the Noachian deluge. In 1709 Scheuchzer of Switzerland defended this view in his "Herbarium diluvianum," a large work in which he described and figured many fossil plants, referring them to species living in Europe. In 1718 this author went so far as to classify the fossil plants according to the system of Tournefort. In 1723 he published a new edition of the

"Herbarium diluvianum," in which he introduced this classification and enumerated 445 species. A powerful reaction against this method followed; comparisons with living plants were carefully made which failed to establish the identity of the fossils. The idea of their exotic origin was thereupon suggested and for a time prevailed, but towards the close of the eighteenth century this in turn gave way to the true view of the existence of former geologic periods with floras of their own differing from that of the present. Baron von Schlotheim headed this new school and was followed by Count Sternberg and Adolphe Brongniart, who jointly founded the science of vegetable paleontology in the first quarter of the present century.

The first attempt to place it on the footing of a systematic science was made by the Rev. Henry Steinhauer of Bethlehem, Pennsylvania, in a paper read before the American Philosophical Society and published in its "Proceedings" for the year 1818. In this paper he described and figured ten species of Waller's genus Phytolithus, which was made to embrace nearly all forms of vegetable fossils. Two years later Schlotheim in his "Petrefactenkunde" applied specific names to seventy-eight fossil plants. Brongniart, in his "Prodrome" published in 1828, went much farther. He referred many fossil plants to living genera and created a large number of new extinct genera. He enumerated 501 species, many of which were fully characterized and thoroughly illustrated in his "Histoire des végétaux fossiles."

A census of fossil plants was taken by Unger in 1845 which showed that the number of known species had increased to 1,648. In 1848 Göppert made a similar enumeration and found 2,055 species. The extraordinary activity that followed in the developing of new fossil floras rendered it possible for Schimper in 1874 to describe about 6,000
495 species in his great work "Traité de palé | ontologie végétale." The decade which has elapsed since the
appearance of that work has witnessed extensive investi-

gations in this field, particularly in the arctic regions and in the United States, and the number of fossil species now known to science is probably between eight and nine thousand.

[A table accompanied the paper showing the numerical development of the fossil flora.]

193. Geological View of the Fossil Flora of the Globe—Abstract

History.—Written Aug. 27, 1884. Read Sept. 8, 1884. See Nos. 142, 180, 183, supra, pp. 129, 378, 388; also Nos. 195 and 208.

Ibid., pp. 495–496.

THE most ancient vegetable remains known are two species of Oldhamia from the Cambrian of Ireland. From the Lower Silurian forty-four species, chiefly marine algae, have been named. Among these, however, are included the earliest terrestrial forms, viz., *Eopteris Morierei*, Sap., *Sphenophyllum primaevum*, Lx., and two other vascular plants from the Cincinnati group. Of the thirteen species of the Upper Silurian five are vascular plants, and these include *Cordaites Robbii*, Dawson, from Hérault. The Devonian furnish 188 species of fossil plants in which ferns play the leading rôle, while from Permo-carboniferous strata nearly 2000 species are known. Only sixty-seven species are found in the whole of the Trias. With the Rhetic a new impulse is felt increasing to the Oölite, in which 419 species occur. The Upper Jurassic and lower Cretaceous are sparingly supplied with the remains of vegetation, but in the Cenomanian, to which the beds of Atane, Greenland and our own Dakota group of Kansas and Nebraska are referred, nearly 500 species of fossil plants have already been found. The Turonian, with its probable equivalent in the west, the Fort Benton group, is nearly destitute of vegetable remains, but the Senonian immediately overlying it with which the Canadian geologists have correlated certain rich plant beds of British Columbia, and to which Heer's flora of Patoot, Greenland, must be referred, yields more than 350 species. The Laramie group of the western United States is thought to be extreme upper Cretaceous. This is very rich in plants and 333 species have already been described from the horizon.

The Tertiary flora is much more abundant even
than that of the Carboniferous. The Eocene fur- 496
nishes nearly 800 species (including our Green River group and the Paleocene beds of Sézaane and Gelinden). The Oligocene of Europe yields a somewhat larger number. The maximum is attained in the Miocene, from which more than three thousand fossil plants are known. The Miocene practically closes the geological series so far as vegetable paleontology is concerned. Only about 150 Pliocene species exist, and a still smaller number from the Quaternary.

[The paper was illustrated by a table showing the flora of each geological formation, and by a diagram illustrating the thickness of the strata in each and the fluctuations in the development of plant life.]

194. Botanical View of the Fossil Flora of the Globe.—Abstract

History.—Written Aug. 29, 1884. Read Sept. 8, 1884. See Nos. 142, 180, 183, supra, pp. 129, 378, 388; also Nos. 195 and 208.

Ibid., pp. 496–497.

I. *First appearance of types.* The Oldhamias of the Cambrian, mentioned in the last paper, are marine algæ of the order Florideæ. The Ferns, Esquisetineæ, and Lycopodineæ all appeared in the Lower Silurian. One species of Cordaites, which is now regarded as the ancestral type of the Coniferæ, occurs in the Upper Silurian. The Rhizocarpeæ, according to Dawson, existed in the Devonian of Canada and Brazil. The Cycadaceæ and the Monocotyledons have their earliest known representatives in the Carboniferous. The order Gnetaceæ is represented, according to Heer, in the Oölite of Siberia by his species *Ephedrites antiquus*. The Dicotyledons first appeared in the Urgonian of Kome, Greenland, through Heer's single species *Populus primæva*. All three of the divisions of dicotyledonous plants occur in great abundance in the Cenomanian. If the genus Selaginella is regarded as belonging to the Ligulatæ, this small transitional type also first appears in the Cenomanian, at Atane, Greenland.

All the leading types of vegetation are thus introduced without coming down the geological scale later than the middle Cretaceous.

II. *Age of maximum relative predominance of each type.* The marine algæ, being the only vegetation, 497
were supreme during the Cambrian and early Silurian. The maximum relative predominance of each of the other principal types was reached as follows: The Ferns in the Permian, the Equisetineæ and Lycopodineæ in the Carboniferous, the Cycadaceæ in the Lias or Oölite, the Coniferæ in the Wealden or Neocomian, the Monocotyledons in the Eocene, the monochlamydous Dicotyledons in the Cenomanian, the polypetalous Dicotyledons in the Miocene, and the gamopetalous Dicotyledons in the present living flora of the globe.

III. *Probable true period of origin and of maximum absolute development of each type.* Cellular Cryptogams of some kind probably lived in the Laurentian and account for the graphite beds and dark, carbonaceous matter of certain Archæan rocks. Being an heterogeneous group their later representatives belonged to entirely different families. If we include the Fungi the number of species is probably greater in the living flora than it was at any geological epoch. The Ferns, Equisetineæ, and Lycopodineæ probably all originated in the Lower Silurian and reached their absolute maximum in the Carboniferous. The Cycadaceæ may have originated as early as the Devonian. They must have attained their absolute as well as their relative maximum development in the middle Jurassic. The Coniferæ through their archaic form, the Cordaiteæ, began in the Lower Silurian. They attained their full maturity in the Cretaceous and are now on the decline. The Monocotyledons probably date back to the Lower Carboniferous or Devonian and reached their highest expression in the palms whose reign occupied the early Tertiary. These also are probably now waning. The Dicotyledons must have had their real origin in the lower Jura or upper Trias. Their absolute probably coincides with their relative development, the Apetalæ being now declining, the Polypetalæ about stationary, and the Gamopetalæ rapidly advancing.

[Diagrams showing the observed relative development and the probable origin and progress of each of the principal types of vegetation were employed to illustrate this paper.]